ICivilTech

International Symposium on Innovations in Civil Engineering and Technology

ABSTRACT BOOK

October 30-November 1, 2024
Isparta-TURKIYE

https://iciviltech2024.sdu.edu.tr/

2nd International Symposium on Innovations in Civil Engineering and Technology

(I CivilTech 2024)

ABSTRACT BOOK

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SYMPOSIUM ABSTRACT BOOK

Second International Symposium on Innovations in Civil Engineering and Technology (2nd I CivilTech)

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(Listed by title and alphabetical order.)

29 EKİM CUMHURİYET BAYRAMI'NIN 101. YIL DÖNÜMÜ ANISINA

CUMHURİYETİMİZİN İLANININ 101. YIL DÖNÜMÜNDE, GAZİ MUSTAFA KEMAL ATATÜRK VE SİLAH ARKADAŞLARINI SAYGI, MİNNET VE RAHMETLE ANIYORUZ. CUMHURİYETİMİZİN KAZANIMLARINI KORUMA VE GELECEĞE TAŞIMA SORUMLULUĞUYLA BİR ARAYA GELDİĞİMİZ BU SEMPOZYUMDA, BİLİMSEL ÇALIŞMALARIMIZI CUMHURİYETİN IŞIĞINDA DAHA İLERİYE TAŞIMAYI AMAÇLIYORUZ.

CUMHURİYET BAYRAMIMIZ KUTLU OLSUN!

CivilTech

FOREWORD

Civil engineering is a fundamental discipline that creates and maintains the infrastructure of societies. Civil engineers are responsible for designing safe, durable and sustainable structures, from buildings to bridges, highways, railways, airports, ports and dams.

Turkiye is a country that frequently experiences earthquakes. The earthquakes centered in Kahramanmaras that occurred on February 6, 2023 and affected 11 provinces, once again revealed how important the profession of civil engineering is. This tragic event brought to the agenda not only the loss of life and destruction, but also the importance of awareness about the earthquake resistance of structures.

Similar situations are experienced worldwide; natural disasters, climate change and environmental conditions require the development of civil engineers and their updating according to the requirements of the age. Sustainable designs, green building applications, smart city solutions, artificial intelligence applications are important trends in the field of civil engineering. At this point, civil engineers need to not only design structures but also take environmental impacts into consideration.

As a result, civil engineering is of great importance worldwide. The February 6 earthquake reminded us that this profession is not just a construction activity, but also a critical area that directly affects human life and safety. In this context, the responsibilities of civil engineers are increasing; they need to continuously develop the knowledge and skills required to ensure the safety of structures, protect human life and develop sustainable solutions.

For this purpose, the first International Symposium on Innovations in Civil Engineering and Technologies (ICivilTech) hosted by Afyon Kocatepe University in Afyonkarahisar, Turkiye in 2019 was a great scientific event where academicians, industry representatives and students came together to present and discuss the latest developments and innovations in the field of Civil Engineering. Due to the pandemic process, we are experiencing, it was decided that the second symposium after 5 years will be held in Isparta/Turkiye on October 30th-November 1st, 2024 hosted by Suleyman Demirel University.

The symposium aims to bring together academicians, industry representatives and students at Süleyman Demirel University to promote new ideas, innovative applications and knowledge sharing at the intersection of civil engineering and technology and to discuss the latest developments in the field. In the 2nd iCivilTech symposium, a total of 86 papers from 18 different countries (Algeria, Bangladesh, China, Croatia, Georgia, Greece, India, Iraq, Italy, Kazakhstan, Pakistan, Poland, Russian Federation, Slovenia, Sweden, Ukraine, United States, Vietnam) will be presented face-to-face and online. In addition, invited speakers from five different countries, Prof. Dr. Halil Ceylan, Assoc. Prof. Dr. Luigi Pariota, Assoc. Prof. Dr. Borut Macuh, Assoc. Prof. Dr. Aman Garg, Assist. Prof. Dr. Selçuk İz will make presentations on the latest developments in traffic, geotechnical, mechanical and steel structures. In the sessions to be held, expert academics, researchers and industry representatives will share with us and the relevant industry the research results and technologies that will shape the future of civil engineering. I believe that the interactions between the participants will allow our knowledge and experience to be

further enriched. I hope that the 2nd ICivilTech symposium will open the door to new academic collaborations, creative solution suggestions and inspiring exchanges of ideas in the field of civil engineering. I would like to thank all participants, the members of the executive board who contributed to the work of the symposium, our valuable researchers who supported us with their papers, our participants and all the universities that supported us. I hope that the symposium will be beneficial.

Prof. Dr. Mehmet SALTAN
Rector of Suleyman Demirel University

Programme

2ND INTERNATIONAL SYMPOSIUM ON INNOVATIONS IN CIVIL ENGINEERING AND TECHNOLOGIES

31 OCT 2024 | THURSDAY

DAY2 - LÜTFÜ ÇAKMAKÇI CONVENTION CENTER

HALL A

09:15-10:00	**OPENING CEREMONY**
10:00-10:30	**KEYNOTE SESSION** **LUIGI PARIOTA (PH.D.) (INVITED SPEAKER)** EXPERIMENTS CONCERNING THE USE OF MACROSCOPIC FUNDAMENTAL DIAGRAM-BASED HIERARCHICAL CONTROL OF URBAN TRAFFIC
10:30-12:15	**SESSION 1** — **SESSION CHAIR: PROF. DR. SERDAL TERZİ**
10:30-10:45	INVESTIGATION OF THE NYLON BAG WASTE MODIFIED BITUMEN PROPERTIES CAHİT GÜRER, BOJAN ZLENDER, SÜLEYMAN GÜCEK, PRIMOZ JELUSIK, BURAK ENİS KORKMAZ, ŞULE YARCI, MURAT VERGİ TACİROĞLU, TAMARA BRAČKO, BORUT MAČUH, ROK VARGA
10:45-11:00	CATEGORIZING URBAN NETWORK SEGMENTS FOR CYCLISTS' USE FOR MULTI-OBJECTIVE ROUTING KONSTANTINOS THEODORESKOS, KONSTANTINOS GKIOTSALITIS
11:00-11:15	A COMPARATIVE INVESTIGATION OF THE EFFECTS OF GEOMETRIC DIFFERENCES IN WEAVING AREAS IN THE UNITED KINGDOM AND TÜRKIYE METİN MUTLU AYDIN, EREN DAĞLI
11:15-11:30	DEVELOPING PUBLIC TRANSPORTATION INFORMATION SYSTEMS AT CITY ENTRY POINTS: PUBLIC TRANSPORTATION INTEGRATION SCORE ABDULKADİR ÖZDEN, SÜLEYMAN NURULAH ADAHI ŞAHİN
11:30-11:45	EVALUATION OF EMERGENCY ENTRY MANEUVERS FOR AMBULANCES IN TERMS OF ROAD DESIGN: THE CASE OF SDÜ FACULTY OF MEDICINE AYŞE ÜNAL, MELTEM SAPLIOĞLU
11:45-12:00	STATISTICAL PREDICTION OF BITUMEN RUTTING PARAMETER JÜLİDE ÖNER
12:00-12:15	RAIL THERMAL BUCKLING RISK MANAGEMENT: COMPARATIVE ANALYSIS OF STRESS-FREE TEMPERATURE DETERMINATION IN THE USA AND TÜRKIYE MEHMET SALTAN, FERHAT ÇEÇEN, ÖMER FARUK ACAR
12:15-12:45	**KEYNOTE SESSION** **AMAN GARG (PH.D.) (INVITED SPEAKER)** BOOTSTRAP-BASED MACHINE LEARNING ALGORITHM FOR INVESTIGATING STOCHASTICITY IN COMPRESSIVE STRENGTH OF CONCRETE
12:45-13:30	**LUNCH BREAK**

13:30-14:00	**KEYNOTE SESSION** **SELÇUK İZ (PH.D.) (INVITED SPEAKER)** THE EFFECT OF WALL FORM AND RAW MATERIAL HUMIDITY AND DUST EXPLOSION ON SILO PRESSURE IN GRAIN SILOS
14:00-14:30	**KEYNOTE SESSION** **BORUT MACUH (PH.D.) (INVITED SPEAKER)** FEASIBILITY OF USING GEOSYNTHETICS IN GEOTECHNICAL STRUCTURES
14:30-14:45	QUESTION AND ANSWERS
14:45-15:00	**COFFEE BREAK**
15:00-15:30	**KEYNOTE SESSION** **HALİL CEYLAN (PH.D.) (INVITED SPEAKER)** AI IN TRANSPORTATION GEOTECHNICS: UNLOCKING COMPLEX Solutions for a New Era
15:30-15:45	QUESTION AND ANSWERS
15:45-17:00	**SESSION 2** — **SESSION CHAIR: PROF.DR.MESUT TİĞDEMİR**
15:45-16:00	INVESTIGATION OF CONDUCTIVITY AND MECHANICAL PROPERTIES OF ELECTRICALLY CONDUCTIVE ASPHALT CONCRETE PRODUCED FROM HYBRID AGGREGATE CAHİT GÜRER , HAKKI ARDA DÜZGÜN, HÜSEYİN AKBULUT, BURAK ENİS KORKMAZ , AYFER ELMACI KORKMAZ
16:00-16:15	THE EFFECT OF MODULUS OF ELASTICITY AND LAYER THICKNESS ON THE DESIGN LIFE OF FLEXIBLE PAVEMENTS MERVE BOŞNAK, MURAT VERGİ TACİROĞLU
16:15-16:30	INVESTIGATION OF THE EFFECTS OF USING WASTE VEGETABLE MARGARINE IN BITUMEN MODIFICATION GİZEM KAÇAROĞLU, ÖZNUR KARADAĞ, MEHMET SALTAN
16:30-16:45	INTERVENTION MAPPING FOR TRAFFIC CRASHES IN TÜRKİYE AHMED PAKSOY, SONER HALDENBİLEN, HALİM CEYLAN
16:45-17:00	USING ASPHALT PAVEMENT INSTEAD OF BALLAST AND SUBBALLAST LAYERS IN RAIL TRACK TUĞÇE AKILLI TÖRER, CAHİT GÜRER, KUBİLAY ASLANTAŞ

10:30-12:15	SESSION 3	SESSION CHAIR: PROF.DR.HASAN ÖZKAYNAK
10:30-10:45	BENDING ANALYSIS OF FUNCTIONALLY GRADED BEAMS USING HIGHER ORDER SHEAR DEFORMATION THEORY INCLUDING THICKNESS STRETCHING EFFECT DOĞAN KANIĞ, YONCA BAB, AKİF KUTLU	
10:45-11:00	3 BOYUTLU YAZICILARIN İNŞAAT SEKTÖRÜNDE KULLANIMI FERDİ GEVREK, LALE ATILGAN GEVREK	
11:00-11:15	EVALUATION OF MONOLITHIC CONSTRUCTION QUALITY ACCORDING TO THE ECONOMIC INDICATOR ELINA KRISTESIASHVILI, LEILA KRISTESIASHVILI, IA MSHVIDOBADZE, IRMA GHARIBASHVILI	
11:15-11:30	STUDY OF VIBRATIONS OF FRAME BUILDINGS AS A DISCRETE CONTINUOUS SYSTEM DURING AN EARTHQUAKE UNDER IMPULSE ACTION GELA KIPIANI, ANA TABATADZE, MALKHAZ TSIKARISHVILIE	
11:30-11:45	PRODUCTION OF ENVIRONMENTALLY FRIENDLY FOAM CONCRETE USING WASTE MATERIAL: EFFECTS OF WASTE CONCRETE SLUDGE AND FIBER ADDITIVES İHSAN TÜRKEL, MEHMET UĞUR YILMAZOĞLU, İFFET GAMZE MÜTEVELLI ÖZKAN, GÖKHAN KAPLAN	
11:45-12:00	IMPACT OF THE EUROPEAN GREEN DEAL AND CIRCULARITY ON LEED PROJECTS ŞEYDA ADIGÜZEL ISTIL	
12:00-12:15	MULTIFUNCTIONAL UTILISATION OF MARBLE WASTES IN ONE-PART AND TWO-PART GEOPOLYMER PRODUCTION METHODS: APPLICATIONS AS FILLER AND FINE AGGREGATE BURAK BODUR, M.A. MECİT IŞIK,GÖKHAN KAPLAN, OĞUZHAN YAVUZ BAYRAKTAR	
15:45-17:15	**SESSION 4**	**SESSION CHAIR: PROF.DR.MURAT KANKAL**
15:45-16:00	INVESTIGATION OF MEDITERRANEAN REGION PRECIPITATION AND TEMPERATURES WITH INNOVATIVE POLYGON TREND ANALYSIS TAHSİN BAYKAL	
16:00-16:15	AN INVESTIGATION ON THE MECHANICAL BEHAVIOURS OF CONCRETE GRAVITY DAM TUBA AYDIN	
16:15-16:30	USING MACHINE LEARNING ALGORITHMS WITH OVER SAMPLING TECHNIQUES FOR SEDIMENT TRANSPORT PREDICTION TAHSİN BAYKAL	
16:30-16:45	TEMPORAL ANALYSIS OF DROUGHT AT THE ULUDAĞ METEOROLOGICAL STATION, BURSA, TÜRKIYE MURAT ŞAN, MURAT KANKAL	
16:45-17:00	KIZILIRMAK BASIN HYDROLOGICAL DROUGHT ANALYSIS ÖZLEM TERZİ, TAHSİN BAYKAL, EMİNE DİLEK TAYLAN	
17:00-17:15	INVESTIGATION OF THE EFFECTS OF TWO DIFFERENT BIOPOLYMERS ON THE STRENGTH PARAMETERS OF SILTY SOIL HALIL OĞUZHAN KARA, MEHMET UĞUR YILMAZOĞLU	

09:30-11:00	**SESSION 5**	**SESSION CHAIR: PROF. DR. SERDAL TERZİ**
09:30-09:45	FROM KEYWORDS TO TRENDS: BIBLIOMETRIC ANALYSIS OF ARTIFICIAL INTELLIGENCE METHODS IN ASPHALT PAVEMENT RESEARCH WITH R-STUDIO PROGRAM FATİH ERGEZER, SERDAL TERZİ	
09:45-10:00	EXAMINATION OF THE PROPERTIES OF 70/100 BITUMEN MODIFIED WITH ACTIVATED CARBON ÖZNUR KARADAĞ, GİZEM KAÇAROĞLU, MEHMET SALTAN	
10:00-10:15	RUTTING RESISTANCE IN BASALT FIBER REINFORCED RECYCLED ASPHALT PAVEMENT DOLUNAY ZENGİN, HALİM CEYLAN, SONER HALDENBİLEN	
10:15-10:30	A NOVEL STRUCTURAL HEALTH ASSESSMENT APPROACH FOR THE BALLASTED CONCRETE RAILWAY SLEEPERS FERHAT ÇEÇEN, BEKİR AKTAŞ	
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DAY3 - ONLINE SEMINAR

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10:00-10:10	GEOLOGICAL SPATIAL BASED MODELLING FOR ECONOMIC IMPERATIVES IN PRELIMINARY SITE INVESTIGATION BERNA ÇALIŞKAN
10:10-10:20	IMPROVING TUNNEL SAFETY THROUGH LED LIGHTING FOR LONG TUNNELS: A DRIVING SIMULATOR STUDY OMER FARUK OZTURK, YUSUF MAZLUM, EMINE CORUH, METIN MUTLU AYDIN, HALIM FERIT BAYATA
10:20-10:30	COMPARATIVE ANALYSIS OF SEISMIC DESIGN RESULTS FOR HIGH SPEED RAILWAY BRIDGES ACCORDING TO DIFFERENT STANDARDS ÜSAME EKİCİ
10:30-10:40	WATER POLDERS: A TOOL TO MITIGATE CLIMATE CHANGE JAKUB KOSTECKI, MARTA GORTYCH
10:40-10:50	İÇME SUYU DAĞITIM ŞEBEKESİNDE BASINÇ, HIZ VE YÜK KAYBI DEĞİŞKENLERININ FARKLI SAYISAL YÖNTEMLER İLE ADANA İLİ ÖRNEK UYGULAMALARI ÜZERINDEN MODELLENMESİ BUSE DUYAN ÇULHA, EVREN TURHAN
11:00-12:10	**ONLINE 3 SESSION CHAIR: CONSTRUCTION+GEOTECH**
11:00-11:10	CEMENT BOUND BASE COURSE WITH WASTE RUBBER – EXPERIENCES FROM TRIAL SECTION/TEST FIELD CONSTRUCTION IVANA BARIŠIĆ, MARTINA ZAGVOZDA, IVANKA NETINGER GRUBEŠA
11:10-11:20	DIGITAL TRANSFORMATION OF CONSTRUCTION MANAGEMENT WITH THE USE OF AUTOMATED TECHNOLOGY "BUILDING MANAGER" DMYTRO CHASHYN, KJARTAN GUDMUNDSSON, DMYTRO YAREMENKO , VIKTOR KLEPA
11:20-11:30	COST-EFFECTIVENESS AND PERFORMANCE EVALUATION OF FOUR STRUCTURAL SYSTEMS: FRAMED, SHEAR WALL-FRAMED, TUBE-IN-TUBE, AND OUTRIGGER IN G+30 STORIED BUILDINGS USING ETABS MD FAYSHAL, SANJIDA SHIRIN URMI, ARNOB SARKER, ABDULLAH AL MAHIN
11:30-11:40	SOIL-STRUCTURE INTERACTION EFFECTS ON RC BUILDING RETROFITTED BY SHOTCRETE PANELS PINAR TEYMÜR
11:40-11:50	MULTI-CAMERA BASED MONITORING OF THE STRUCTURAL HEALTH OF HISTORICAL MASONRY MINARETS CEMILE DUMAN, TUNAHAN ASLAN, KEMAL HACIEFENDIOĞLU, TEKIN GÜLTOP
11:50-12:00	THE ROLE OF BUILDING MATERIALS IN HOUSING PURCHASES: A MULTI-CRITERIA DECISION-MAKING APPROACH USING THE COCOSO METHOD UFUK AYDOĞMUŞ, MERDAN TÖREHAN TURAN, HACER YUMURTACI AYDOĞMUŞ

CivilTech
2nd International Symposium on Innovations in Civil Engineering and Technologies
October 30 – November 1, 2024, Isparta / TURKIYE

International Keynote Lecture

Experiments Concerning the Use of Macroscopic Fundamental Diagram-Based Hierarchical Control of Urban Traffic

Assoc. Prof. Dr. Luigi Pariota

Transportation Engineering, University of Naples "Federico II" Italy

Abstract

Traffic congestion frequently occurs on urban networks and various control frameworks are employed to mitigate such congestion at the network level. Hierarchical traffic control frameworks have also gained great interest in the recent literature, having been shown to lead to increased mobility and efficient use of network capacity.

In this presentation, we will show the results of various experiments concerning the application of a hierarchical route guidance (RG) traffic control framework based on the Macroscopic Fundamental Diagram paradigm.

The evaluation is based on the modelling of some relevant urban scenarios in the simulation software Simulation of Urban MObility (SUMO).

It will be shown that overall the proposed network-level traffic control system could significantly enhance several characteristics of the urban traffic environment.

International Keynote Lecture

Bootstrap-Based Machine Learning Algorithm for Investigating Stochasticity in Compressive Strength of Concrete

Assoc. Prof. Dr. Aman Garg

State Key Laboratory of Intelligent Manufacturing Equipment and Technology, School of Mechanical Science and Engineering, Huazhong University of Science and Technology, Wuhan 430074, China
Department of Multidisciplinary Engineering, The NorthCap University, Gurugram, Haryana 122017, India

Abstract

Compressive strength is the most important property of the concrete mix. In the present work, the Gradient Boosting Machine (GBM) learning algorithm is applied in the framework of Bootstrap for predicting the influence of uncertainties in the quantities of cement, blast furnace slag, fly ash, water, superplasticizer, aggregate, and age on the compressive strength of concrete. At first, the correlation coefficients are obtained for all the variables using Pearson, Spearman Rank, Kendall Tau, and Point-Biserial Correlation coefficients are obtained. The efficiency of the present approach is demonstrated by comparing the present results with those obtained using Monte Carlo simulations. It can be seen that the present model predicts the stochasticity in compressive strength with good accuracy but requires lesser dataset and computational efforts compared to the MCS. During sensitivity analysis, age is the most important parameter affecting the stochastic compressive strength of concrete at noise levels, followed by cement content.

Keywords: Bootstrap; gradient boosting machine; uncertainty; stochastic compressive strength; sensitivity.

International Keynote Lecture

Feasibility of using Geosynthetics in Geotechnical Structures

Assoc. Prof. Dr. Borut Macuh

University of Maribor, Faculty of Civil Engineering, Transportation Engineering and Architecture, Slovenia

Abstract

A comprehensive analysis of geosynthetics' technical, economic, and sustainable benefits in geotechnical structures will be presented. Case studies include road pavements, bridge abutments, strip foundations, and piled embankments. Mathematical models are developed to compare reinforced and non-reinforced options, considering cost, technical feasibility, and sustainability. Results show that geosynthetics can significantly reduce costs, especially in challenging soil conditions. For example, reinforced road pavements can be more cost-effective than traditional methods at low CBR values, and reinforced bridge abutments can be up to five times cheaper than conventional concrete ones. Reinforced pads under strip foundations are justified for high vertical loads and low horizontal loads. In piled embankments, higher-strength geosynthetics can be more economical, though they increase costs.

Keywords: Geosynthetics, geotechnical structures, reinforced soil, cost optimization, sustainable construction, piled embankments.

International Keynote Lecture

AI in Transportation Geotechnics: Unlocking Complex Solutions for a New Era

Prof. Dr. Halil Ceylan, Dist.M.ASCE

Pitt-Des Moines, Inc. Endowed Professor in Department of Civil, Construction and Environmental Engineering (CCEE)
ISU Site Director for FAA PEGASAS Center of Excellence on General Aviation
Founding Director, Program for Sustainable Pavement Engineering and Research (PROSPER) Institute for Transportation (InTrans)
Iowa State University (ISU), United States

Abstract

Transportation geotechnics deals with the geotechnical challenges faced in the construction and maintenance of transportation infrastructure systems, encompassing roads, highways, railways, underground transit systems, airfields, and waterways. The inherent complexity of soil and rock behaviors in these contexts introduces significant uncertainties in material modeling. In the past few decades, researchers have increasingly turned to artificial intelligence (AI) methods to address these challenges in transportation geotechnics, effectively predicting complex, nonlinear relationships. This presentation provides a comprehensive overview of the effectiveness of AI methods in transportation geotechnics during the recent decade. It highlights key areas where AI methods have been extensively applied and explores case studies and success stories, demonstrating the application of AI in this field. Additionally, it emphasizes the proficiency of these methods in addressing complex challenges, especially in dealing with highly nonlinear data relationships and meeting demanding optimization requirements.

Local Keynote Lecture

The Effect of Wall Form and Raw Material Humidity and Dust Explosion on Silo Pressure in Grain Silos

Assist. Prof. Dr. Selçuk İZ

Yeditepe University, Depertmant of Civil Engineering, Istanbul, Turkiye

Abstract

In our country, steel silos, which are used for grain storage, have been damaged recently. In this study, the calculation criteria between international specifications and our country's specifications were compared, the effects of the roughness and form on the silo wall pressures and friction, and the effects of the moisture content of the raw material on the silo wall pressures were investigated. Silo walls are produced in sinusoidal form in steel prefabricated silos. Sinusoidal form should not be ignored in both friction and silo pressures. The humidity ratio must be taken into consideration in the silo wall pressures of the raw material, especially in grain silos, and these raw material effects have been summarized in studies conducted for damaged silos. In addition, an algorithm is given in this study regarding the maximum pressures that may occur on the silo walls in case of a dust explosion.

Keywords: Silos, dust explosion, wall form, material humidity, wall pressure, grain

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Alternatif Malzemelerle Tasarlanmış Baca Sisteminin Binanın Enerji Verimliliğine Katkısının Optimizasyonu

Ahmet Karahan[1], *Figen Balo*[2]

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Özet

İnşaat sektörünün en önemli özelliklerinden biri birçok yönden düzenlemeye açık olmasıdır. Bu düzenlemeler farklı malzeme kullanımı, farklı cihaz ve ekipman kullanımı vb. birçok alanda yapılabilmektedir. Alternatif bileşenlerle yapılan projelendirmeler inşa edilen yapının istenilen standartlara ulaşması konusunda oldukça etkindir. Bir binanın enerji verimliliği, binanın zemin alanının metrekaresi başına enerji tüketiminin, tanımlanmış iklim koşulları altında söz konusu bina tipi için belirlenen enerji tüketimi kriterlerini karşılama derecesidir. Enerji verimliliği konusunda erken tasarım aşamasında yapılabilecek düzenlemeler sayesinde oldukça performanslı yapılar oluşturulabilir. Düzenleyici uygulamalarla ilgili örnek çalışmalar, hem konut inşaatı projelerinde hem de çeşitli inşaatlarda verimliliğin artırılmasına yönelik bir yol sağlayabilir. Enerji verimli tasarımlar için bölgesel iklim şartlarını da dikkate alarak ve uygun malzemeler seçerek yapılan performansa yönelik projelendirmelerin yaygınlaştırılması inşaat sektörü üzerinde enerji verimliliği açısından önemli bir etki yaratabilir. İnşaatlarda enerji verimliliğini arttırmanın geliştirilmesi amacıyla yapılacak düzenlemelerden biride ısıtma cihazlarının verimliliğini arttırmaktır. Bu anlamda ısıtma cihazlarının enerji verimliliğini doğrudan etkileyen sistemlerden biri olan baca sisteminde tasarım aşamasında yapılabilecek düzenlemelerle ısıtma cihazlarının daha verimli çalışması sayesinde binanın enerji performansına katkı sağlanabilecektir. Bu çalışmada, Isparta ili iklim şartlarında tasarlanan ofis binasının enerji verimliliğini desteklemek amacıyla KesaAladin simülasyon programı kullanılmıştır. Tasarlanan bina 150 000 Kcal/h kapasitesinde kömürü enerji kaynağı olarak kullanan bir ısıtma cihazı ile ısı enerjisini sağlamaktadır. Kare ve dikdörtgen baca kesitli olmak üzere iki farklı formda tasarlanan baca sisteminde baca tasarım malzemesi olarak dört farklı malzeme [hafif dolu beton (hafif), hafif boş beton (hafif), hafif beton (hafif), asbest beton] kullanılması durumunda tasarlanan alternatif senaryolar simülasyon analizi ile elde edilen sonuçlar dahilinde kıyaslanarak binanın enerji verimliliğine etkisi tespit edilmiştir.

Anahtar kelimeler: KesaAladin simülasyon programı, baca tasarımı, binalarda enerji verimliliği, hafif beton, çevre kirliliği

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Binalarda Farklı Yalıtım Malzemesi Kalınlıklarıyla Tasarlanmış Bacaların Çevresel Etkilerinin Simülasyonla Analizi

Ahmet Karahan[1], *Figen Balo*[2]

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Özet

Dünyada enerjinin en yoğun olarak kullanıldığı sektörlerden birisi de yapı sektörüdür. Bu nedenle yapı sektörü enerji verimliliği açısından dikkate alınması gereken en önemli sektörlerden biridir. Belirli bir bölgede yer alan bir binanın enerji verimliliğine etki eden parametrelerinin analiz edilmesiyle yapılan düzenlenmeler, o bölgedeki farklı bina türlerine ilişkin düzenlemeler için örnek teşkil edebilir. Tipik parametrik değerlere göre yapılan farklı bileşenlerle oluşturulmuş kombinasyonların kıyaslanması, o bölgede konumlandırılmış belirli bir kategorideki tüm binaların ortalama performans seviyesi için yapılabilecek en iyi uygulama ile elde edilebilecek performansı temsil edebilmektedir. Bir binada enerjinin yoğun kullanıldığı ısıtma cihazlarının verimliliğini arttırmak üzere yapılacak küçük değişiklikler toplamda yüksek enerji tasarrufları sağlayabilir. Isıtma cihazlarının verimliliğini arttırmak için müdahale edilebilecek sistemlerden baca sisteminin standartlara ve bölgesel iklim şartlarına göre detaylı hesaplamalar yapılarak tasarlanması hem ısıtma cihazlarının verimliliğini artırma konusunda direk etki edecek hem de daha az enerji kaynağı kullanımı ile daha az çevreyi kirletici emisyon salınımı ve daha az enerji kaynağı maliyeti ile çok yönlü tasarruf sağlama konusunda binalarda enerji verimliliğine önemli katkılar sağlayabilecektir. Bu çalışmada, Isparta ilinde doğal gaz ile çalışan 200 000 kcal/h kapasitesinde bir ısıtma kazanına sahip bir apartman için oval baca kesitli tasarlanan baca sisteminde üç farklı malzeme [paslanmaz çelik, flex çelik boru, ve ateşe dayanıklı alüminyum ile kaplanmış kaynaklı çelik] ve iki farklı kalınlıkta [35 mm ve 45 mm] taş yünü yalıtım malzemesi kullanılmıştır. Farklı malzeme kombinasyonlarıyla oluşturulan alternatif senaryolar KesaAladin simülasyon programı kullanılarak binanın çevresel performansı açısından yapılan analizler kıyaslamalı olarak değerlendirilerek en çevre dostu baca baca malzemesi kombinasyonu belirlenmeye çalışılmıştır.

Anahtar Kelimeler: KesaAladin simülasyon programı, Isparta ili, çevre kirliliği, yalıtım malzemesi, baca malzemesi

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Comparison of Mechanical Performances of Mold-Cast Geopolymer Mortars and 3D-Printed Geopolymer Mortars under Different Curing Circumstances

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Abstract

In this study, the mechanical strength properties of three different produced fly ash-based geopolymer mortar (GM) mixtures were compared. For this purpose, conventionally mold-cast GM samples were cured for 3, 7, and 28 days under ambient cure (20±2 °C) conditions, and GM samples produced with a 3D printer were created. In addition, conventionally mold-cast GM samples cured for 3, 7, and 28 days under heat cure (60 °C) conditions were also created. These three GM mixtures were subjected to mechanical strength tests at the end of the curing periods. For this purpose, flexural and compressive strength tests were applied. At the end of all curing periods, conventionally mold-cast GM samples cured under ambient cure conditions exhibited the highest mechanical performance. The compressive strength test results of GM samples cured for 28 days and produced with a 3D printer were found to be 20% higher than the heat-cured conventionally mold-cast GM samples. The flexural strength test results of conventionally mold-cast GM samples cured under ambient curing conditions were found to be 13% higher than the GM samples produced with a 3D printer.

Keywords: 3D-printed geopolimer; ambient cure; geopolymer mortar; flexural strength; compressive strength; heat cure.

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Cement Bound Base Course with Waste Rubber – Experiences from Trial Section/Test Field Construction

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Abstract

Within the scientific research project UIP – 2019-04-8195 Cement stabilized base courses with waste rubber for sustainable pavements – RubSuPave, large number of laboratory testing was carried out considering addition of waste rubber to mixtures of cement bound base course for pavement construction. The next step was transferring gained knowledge into field conditions which entailed a large scale production of such mixtures in concrete plants and construction of test fields. Here, results and problems of mixture production in 3 different concrete plants are shown, along with experiences of construction of 2 test fields with such rubberized base course. Production of mixtures with 2% waste rubber in concrete plants resulted in reduction of compressive strength after 7 and 28 days curing, compared to reference mixtures without rubber produced in same concrete plant. However, resistance to freezing was improved with rubber addition. Addition of waste rubber caused problems with large scale production in one of the concrete plant with modern production technology, namely issues with dosing and incorporation of rubber, achieving a homogenous mixture and subsequent maintenance of concrete plant with difficulty of cleaning the mixer of rubber. This implied that for large scale production, technology should be adapted in future considering specifics of production technologies. Both reference mixtures and the rubber ones were later inbuild in pavement base courses of 2 test fields to monitor its behavior in real conditions. Test fields will be monitored through time to determine the behavior of pavements with and without rubberized cement bound base course in order to validate results of previous laboratory research.

Keywords: Cement bound base courses, waste rubber, sustainable pavement, test fields, large scale production

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Integration of Additional Innovative Methods with Smart Materials to Create Green Building Technologies for A More Sustainable and Connected Future

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Abstract

Transitioning to green or sustainable cities is crucial for developing and implementing advanced technologies. Ensuring these technologies are eco-friendly and sustainable is essential to promote architectural advancement. Over the past decade, the development of smart materials has emerged as a new direction that accommodates new urban construction. Integrating innovative methods such as AI-driven design, IoT-enabled buildings, and smart materials can be leveraged to create eco-buildings that are energy-efficient but also adaptive and resilient to changing environmental conditions. This study examines the rapidly evolving field of smart green building technology, with a particular emphasis on self-healing concrete, which may be used with innovative green technology to boost a building's environmental efficiency.

Additionally, this paper illustrates the potential convergence with advanced technologies such as the Internet of Things (IoT) and artificial intelligence (AI). It also comprehensively understands the significance of AI and IoT in enhancing the sustainability and performance of building structures connected with green building technology. It also meticulously examines the integration between AI, IoT, and self-healing materials, the implementation challenges, and the environmental, social, and economic impacts of investing in such technologies. By constituting a strategic relationship between smart materials and innovative methods, this paper argues for the formation of green buildings that are not only sustainable but also actively engaged in promoting an environmentally friendly world.

Keywords: Green building; smart materials; artificial intelligence (AI); internet of things; self-healing

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Investigation of Properties of Barite-Laminateded Wood Composite Material

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Abstract

Composite materials have played a pivotal role, stretching from early civilizations to the present era. The integration of materials to form composites has historically aimed at harnessing properties superior to their components, encompassing enhanced strength, corrosion resistance, flexible designs, durability, and improved strength-to-weight ratios. The wood material is preferred because it is a renewable resource, the amount of energy used in the production of wooden building elements and structures is low, as well as the fact that the amount of carbon dioxide generated during the production process is close to zero when compared to other building materials. When wood composite systems are compared with carrier systems such as steel and reinforced concrete; It enables the production of durable and sustainable structures due to its structural features such as reduction in dead load and earthquake load level acting on the system, high strength/density ratio like steel, high fire resistance, low transportation cost, and fast construction process. In this study, laminated wood composites were produced by using tangentially sawn timber, which is widely used in the forest products industry, by using a dry consistency barite mortar prepared with barite and cement in the intermediate zone. The properties of the obtained composite wood were investigated. The properties of barite-laminated wood composite material are superior to traditional wood-laminateded composite material.

Keywords: Composite; materials; laminated; wood.

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Fire Resistance Properties of Geopolymer Binders Incorporating Construction and Demolition Waste and Slag

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Abstract

Geopolymers and alkali-activated materials serve as alternative binding materials to cement and were initially introduced as fire-resistant materials. Recently, the increasing importance of issues such as sustainability and the circular economy has encouraged the utilization of waste materials and their use in the production of value-added products. Accordingly, construction and demolition waste are utilized in various ways, particularly in the production of geopolymers. Previous studies have demonstrated that construction and demolition waste can be effectively used in geopolymer production like other conventional raw materials (e.g., metakaolin, slag, fly ash, pozzolans), showing promising results in terms of strength and durability under optimal activator content and curing conditions. This study aims to evaluate the fire resistance of geopolymers produced from construction and demolition waste and ground granulated blast furnace slag, specifically examining the effects of the type and amount of activator on fire resistance. The results indicated that geopolymer mortars activated solely with NaOH exhibited the highest fire resistance regarding both flexural and compressive strength losses. In contrast, the addition of Na_2SiO_3 reduced the fire resistance of the mortars. However, it is believed that these outcomes may vary with the use of different raw materials, particularly that better results in terms of fire resistance could be obtained with the addition of sodium silicate to raw materials with high reactivity. The findings underscore the significant potential of tailored activator combinations for optimizing fire-resistant geopolymer applications.

Keywords: Geopolymer; alkali-activated materials; construction and demolition waste; fire resistance.

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Multifunctional Utilisation of Marble Wastes in One-Part and Two-Part Geopolymer Production Methods: Applications as Filler and Fine Aggregate

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Abstract

This study compares the one-part and two-part geopolymer production methods, both of which utilize marble powder as a filler material. Marble powder, when used as a filler, is a promising strategy that can significantly enhance the environmental sustainability of construction materials and reduce carbon emissions. The study produced different geopolymer mixtures by replacing ground granulated blast-furnace slag (GBFS) with marble powder at 0% and 30% levels and using sodium metasilicate as an activator. These mixtures' mechanical properties, workability, bulk density, water absorption, and compressive strength were evaluated, with a specific focus on the role of marble powder as a filler material. The results indicate that the addition of marble powder decreases the viscosity of the geopolymer mixtures, with the one-part method exhibiting increased fluidity. However, it was observed that adding marble powder reduced compressive strength. In contrast, the mixtures produced by the two-part method, while more costly, provided materials with a high level of confidence in their resistance to high temperatures and mechanical loads, demonstrating higher durability and thermal stability. The one-part method, with its increased fluidity, offers a practical and easy-to-apply solution, while the two-part method, despite its higher cost, provides materials with superior resistance to high temperatures and mechanical loads. Both methods, however, offer the unique advantage of significantly reducing carbon emissions when marble powder is used. These findings suggest that marble powder can be used in the production of sustainable construction materials, and the two different production methods offer distinct advantages.

Keywords: Geopolymer production methods; environmental sustainability; carbon emissions; marble powder

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Production of Environmentally Friendly Foam Concrete Using Waste Material: Effects of Waste Concrete Sludge and Fiber Additives

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Abstract

This study investigates the potential of using waste concrete sludge (CS) and polypropylene fiber (PF) to improve the physico-mechanical and thermal properties of foam concrete while promoting sustainability. Foam concrete is known for its lightweight and high thermal insulation properties, and in this research, CS is used as a partial replacement for cement at varying levels (10%, 20%, 30%), while PF is added for reinforcement. The results show that as the CS content increases, the compressive and flexural strength decrease, porosity increases, and density reduces due to the lower binding properties and higher water retention capacity of CS compared to cement. The inclusion of PF partially improves flexural strength and high-temperature resistance by reducing crack propagation, but this effect diminishes at extreme temperatures. In this context, the utilization of waste in building materials plays a crucial role. Incorporating waste into construction materials provides both environmental and economic benefits. The reuse of construction waste, such as concrete sludge, helps reduce material waste, conserve natural resources, and lower the carbon emissions associated with cement production. Particularly in concrete production, the extensive use of cement contributes to increased greenhouse gas emissions. The use of waste materials like CS can mitigate these impacts and enable the production of more environmentally friendly construction materials. In conclusion, while the use of CS in foam concrete shows environmental promise, optimizing the performance of these materials is critical to ensuring both sustainability and structural integrity. This research highlights that utilizing waste materials in the construction industry is a cost-effective and ecologically beneficial approach and underscores the need to expand the potential applications of such materials in the construction sector.

Keywords: Foam concrete, environmental sustainability; carbon emissions; polypropylene fiber; waste concrete sludge

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Investigation of the Use of Organic Fiber Additives in Foam Concrete Production

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Abstract

With the rapid increase in urbanization, concrete is the second most widely used building material in the world. Developing concrete technology contributes to the sustainability of concrete and materials used in concrete. While conventional concrete has a unit weight of 2300 kg/m^3, the unit weight of foam concrete is 300-1800 kg/m3. In addition to reducing costs and environmental impact, it is particularly suitable for special structures requiring advanced technology. Many lightweight concrete products are successfully designed and used in a wide range from traditional housing production to highly complex structures. It has a wide range of applications such as thermal insulation, sound insulation, filling concrete, roof insulation, bridge construction, prevention of fluctuations in bridge approaches, in soft ground base in road construction, raft foundations of buildings, in many infrastructure applications, precast and in-situ casting applications, wall blocks, etc. Foam concrete is lighter in weight and has high sound and heat insulation. In this study, the use of organic human hair and flax as fibers instead of traditionally used fibers in the production of foam concrete was investigated. The aim of the study is to recycle billions of tons of human hair, which is not fossilized, found as waste and causes various environmental problems. Human hair was combined with fly ash, which has pozzolanic properties, as a fiber in the foam concrete. In the fly ash added series, human hair and flax fiber were used in varying proportions between 10 gr and 20 gr. As a result of the experiments, the average compressive strength was determined as 2,551 Mpa and the min 1,.5 Mpa value specified in TS 13655 was provided.

Keywords: Foam concrete, natural fiber additive, recycling, sustainable production.

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Muz Lifinin Alçı Malzeme Özelliklerine Etkisi

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Özet

Alçı malzeme hem Türkiye'de hem de dünyada yaygın olarak kullanılmaktadır. Ancak en büyük dezavantajları düşük dayanım değerleri ve suya karşı hassasiyetidir. Bu çalışma, alçıya belirli oranlarda doğal bir malzeme olan muz lifi ekleyerek mekanik özelliklerini iyileştirmeyi hedeflenmiştir. Muz lifleri farklı boyutlarda ve oranlarda kullanılmıştır. Muz lifi, yüksek çekme dayanımı ve biyolojik olarak parçalanabilir özelliğiyle çevre dostu bir takviye malzemesi sunmaktadır. Muz lifi, doğal bir takviye malzemesi olarak kullanıldığında çevre dostu ve biyolojik olarak parçalanabilir özelliklere sahiptir. Yüksek çekme dayanımı ve düşük yoğunluğu ile bilinir. Bu lif, özellikle kompozit malzemelerde güçlendirme amacıyla kullanılmakta olup, alçı gibi yapı malzemelerinin mekanik özelliklerini artırmada potansiyel sunmaktadır. Lifin doğallığı ve sürdürülebilirliği, inşaat sektöründe yenilikçi çözümler arasında yer almasını sağlamaktadır. İki farklı alçı türü (saten ve kartonpiyer) kullanılmış olup, üretilen numuneler üzerinde basınç ve eğilme testleri yapılmıştır. Sonuçlara göre, en yüksek basınç ve eğilme dayanımı %1 oranında ve 12 mm uzunluğundaki muz lifli numunelerde elde edilmiştir.

Anahtar Kelimeler: Alçı, muz lifi, kompozit

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Creating A Model House Using the Desing Builder Application and Determining the Energy Parameters

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Abstract

First, a comprehensive literature review on energy efficiency and saving was conducted. Necessary information about energy efficient improvement has been given. A detailed topic review was conducted on effective energy interaction in buildings. Two different buildings were designed using the application. Different types of materials were used in buildings. Different types of heating and cooling were used in buildings. As a result of the necessary measurements, the heat transfers, losses and energy consumed in the buildings are presented as a table. As a result of these tables, the thermal insulation amounts resulting from the difference in material types used were examined. The differences in the amount of energy resulting from this difference were examined. The accuracy of two hypotheses that stand out due to the differences in the materials used on the facades and the differences in the heating and cooling systems in the buildings were examined. As a result, it has been confirmed that the use of different materials and systems has a big impact on energy parameters.

Keywords: Energy, Building materials, Energy efficiency, Heating and cooling systems.

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Polipropilen Lif Takviyeli Geçirimli Betonun Mekanik Özelliklerinin İncelenmesi

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Özet

Günümüzde yeraltı su kaynaklarının tükenmekte olduğu görülmektedir. Bu aşırı yeraltı suyunun kullanımının yanı sıra yağış sularının geçirimsiz yol ve kaldırım gibi alanlardan kanalizasyon sistemi vasıtasıyla uzaklaştırılmasından kaynaklanmaktadır. Oysaki doğal döngü içerisinde bu istenmeyen bir durum oluşturmaktadır. Bu amaçla doğal denge sistemi ile barışık betonlar üretilmesi çalışmaları sürmektedir. Bu betonlardan birisi de geçirimli beton çalışmalarıdır. Geçirimli beton bu suları yeraltına drene edebilme özelliğine sahiptir. Bunu karışımında ince agrega barındırmayarak iri agregalar arasından akışın gerçekleşmesi ile sağlamaktadır. Ancak ince agreganın olmaması bu betonların dayanımlarını düşürmektedir. Bu çalışmada geçirimli betonlar polipropilen (PP) lifler ile takviye edilerek üretilmiştir. Bu betonların taze beton özellikleri ve sertleşmiş beton özellikleri incelenmiştir. Üretilen numunelerin 7, 14, 21, 28 gün deneyleri yapılmış ve artan yaş ile dayanımlarda artışlar görülmüştür.

Anahtar Kelimeler: Geçirimli beton, lifli beton, geçirimlilik, beton yaşı

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Volkanik Tüfün Çimento Dayanımına ve Karbon Salınımına Etkisinin Araştırılması

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Özet

Sanayinin gelişmesi ve üretimin artmasıyla birlikte, iklim değişikliğinin olası etkilerinden korunmak amacıyla 1994'te Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi, 2005'te Kyoto Protokolü ve 2016'da Paris Anlaşması yürürlüğe girmiştir. Türkiye, 2021'de Paris Anlaşması'na katılarak bu sürecin paydaşı olmuştur. Bu kapsamda onaylanan Avrupa İklim Yasası ile 2030 yılına kadar net sera gazı emisyonlarının en az %55 azaltılması ve 2050'de iklim nötrlüğüne ulaşılması hedeflenmiştir. Ülkemizde de "2053 Net Sıfır Emisyon" hedefi belirlenmiştir. Çimento endüstrisinin küresel karbon salınımından ciddi derecede sorumlu olduğu ve kişi başına düşen çimento kullanımının yaklaşık yarım tonun üzerinde olduğu bilinmektedir. İklim değişikliğiyle mücadelede sektörün alacağı önlemler kritik bir rol oynamaktadır. Çimento üretiminde açığa çıkan emisyonların büyük kısmı, kireçtaşının yüksek sıcaklıkta fırınlanması ve bu sıcaklıklara ulaşmak için kullanılan yakıtlardan kaynaklanmaktadır. Çimentoların karbon salınımını en aza indirmek, düşük klinker oranına sahip düşük karbon emisyonlu yeşil çimentoların kullanımıyla mümkün olacaktır. Bu da klinker yerine volkanik tüf, tras, gibi yüksek puzolanik aktiviteye sahip bir veya daha fazla mineral katkı maddesinin çimento üretiminde kullanılmasıyla sağlanabilir. Mineral katkılı çimentolar, düşük karbon ayak izine sahip oldukları için daha çevre dostudur ve bu katkılar sayesinde çimentolardan kaynaklanan karbon salınımı azaltılabilir. Bu çalışmada, Isparta Gölcük volkanizmasındaki Gelincik köyünden elde edilen volkanik tüf kullanılmıştır. Çimento miktarına %10, %20, %30 ve %40 oranlarında volkanik tüf ikame edilerek üretilen numunelerin basınç dayanımları karşılaştırılmış ve tüf miktarının artmasıyla dayanımlarda azalma gözlenmiştir. Ancak bu azalma, düşük oranlarda performans arttırıcı kimyasal katkılarla telafi edilmiştir.

Anahtar Kelime: Çimento; volkanik tüf; karbon salınımı; iklim değişikliği.

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The Role of Building Materials in Housing Purchases: A Multi-Criteria Decision-Making Approach Using the CoCoSo Method

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Abstract

Building materials used during the construction phase of housing purchases emerge as one of the key factors influencing consumer preferences. The selection of building materials is a complex decision-making process that involves multiple criteria such as durability, energy efficiency, environmental sustainability, maintenance costs, aesthetics and comfort, cost, sound and thermal insulation, health and safety, and structural security. In this context, the decision-making process can be considered a multi criteria decision making problem. This study aims to evaluate alternative building materials within the framework of criteria determined based on literature and expert opinions. For this analysis, the Combined Compromise Solution (CoCoSo) method, developed by Yazdani et al. in 2019, was employed. The CoCoSo method is an effective tool for solving multi criteria decision making problems, providing a ranking of alternatives. According to the findings obtained within the scope of the study, it was observed that criteria such as durability, energy efficiency, and environmental sustainability were prioritized. The analysis revealed that materials resistant to natural disasters, environmentally friendly, and energy-efficient significantly influenced consumer preferences. Furthermore, it was concluded that these materials provide both economic and environmental benefits in the long term. In light of these results, it is projected that the use of sustainable, durable, and energy-efficient materials in the construction sector will create a competitive advantage at the industry level.

Keywords: Multi criteria decision making; building materials; CoCoSo; consumer preferences.

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Structure

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Bending Analysis of Functionally Graded Beams using Higher Order Shear Deformation Theory Including Thickness Stretching Effect

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Abstract

Purpose: This study introduces a mixed finite element approach for the static analysis of functionally graded beams using Higher-Order Beam Theory.
Study design/methodology/approach: The Higher-Order Beam Theory is employed to describe the kinematic relationships of the functionally graded (FG) beams. The mechanical system's functional is derived using the Hellinger-Reissner principle, incorporating stress resultants along with the kinematic variables of the FG beam. The necessary elasticity and compliance matrices for static analysis are determined.
Findings: The proposed mixed finite element formulation, based on higher order deformation theory, is used to perform flexural analysis of the FG beams considering thickness stretching. The method's effectiveness is demonstrated through convergence and comparison analyses. This beam theory approach accounts for transverse shear deformations and meets zero traction boundary conditions on the beam's top and bottom surfaces without requiring any shear correction factor. The performance of the methodology is revealed considering convergence and comparison analyses
Originality/value: The implementation of the higher order beam theory, along with the mixed finite element method, has proven to be highly efficient in assessing the stress calculation of the functionally graded beams. This study examined the robustness of the numerical method and the mechanical model in predicting the bending behavior of laminated composite beams

Keywords: Functionally graded beams, hellinger-reissner, stretching effect, mixed finite element formulation, higher-order beam theory.

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Depremin Gölgesinde Batman İli: Geçmişten Dersler ve Gelecek için Stratejiler

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Özet

Yüzyılın afeti olan 6 Şubat depreminde doğu Anadolu fay hattı üzerindeki on ilimiz yüksek seviyelerde ve bu illere komşu olan pek çok il ise daha düşük seviyelerde depremden etkilendi. Depremde gördüğü hasar nedeniyle afet bölgesine dâhil edilen Batman ili de depremden etkilenen iller arasındadır. Depremin gölgesinde olan ülkemiz ve muhtemel Bingöl depremi düşünüldüğünde risk düzeyi yüksek olan Batman ilinin geçmişten ders alması ve gelecek için stratejiler geliştirmesi hayati önem taşımaktadır. Batman ili, Kira Dağı, Doğu-Batı Raman Dağları arasında bir vadide medeni olarak gelişmiş bir ildir. Taşkın ve sel riski yüksek olan bir konumda olduğu için genel olarak geoteknik performansı düşük bir karakteristiğe sahip olup, il merkezi genel olarak düşük taşıma kapasitesine sahip bir zemin davranışı sergilemektedir. 6 Şubat depreminde Hatay ilimizdeki bir istasyonda deprem yer hareketi düzeylerinden DD1 spektral ivme değerlerinin bile hem yatay hem de düşeyde aşıldığı tespit edilmiştir. Yüzyılın afetinde Batman ilimizde hissedilen deprem büyüklüğü takriben 5 olarak tespit edilmiştir. Kahramanmaraş merkezli depremin Batman ilimizdeki deprem büyüklüğü neticesinde oluşan hasarlar tamamen talep üzerine yapılan incelemelerle elde edilmiş sonuçlardır. Tüm talepler neticesinde incelenen yapı/bağımsız bölme sayısı tüm ilin yaklaşık %3.4'üne tekabül ettiği ve neredeyse tüm yapıların da (%96.6) hasar tespitinin yapılmadığı gözlemlenmiştir. Öte yandan, hasar tespiti süreçlerinde en zayıf kat olan ticari alanların dış aksında kalan düşey taşıyıcı elemanların dekoratif kaplamalarla kaplı olduğu tespit edilmiştir. Hasar tespiti sırasında kompozit kaplamaların kaldırılmadan yapıların hasar düzeylerinin belirlendiği tespit edilmiştir. Bunun dışında, Batman il merkezinde projesiz güçlendirme uygulamalarına rastlanıldığı ve yapılan uygulamalarla yapıların daha riskli bir hale getirildiği gözlemlenmiştir. Ayrıca, bazı yapılarda en alt katlardaki düşey taşıyıcı yapı elemanlarının dış beton liflerinde meydana gelen çatlak bölgeleri sıyrılmadan tahminen hasar tespitinde bulunulduğu tespit edilmiştir. Son olarak, Batman il merkezinde yer altı su seviyesi yüksek olduğu veya farklı nedenlerle yapıların giriş veya bodrum katları nem aldığı için mevcut yapı stokunun bir kısmında çok yüksek seviyelerde korozyon tespit edilmiştir. Donatıların yatay ve düşey yük etkilerine çalışamayacak kadar işlevsiz hale ulaştıkları gözlemlenmiştir. Batman ilinde tespit edilen tüm bu sonuçlar göz önünde bulundurulduğunda Batman ilimizin ekseriyet itibariyle muhtemel Bingöl depremine hazır olmadığı sonucuna varılmıştır. Gözlemlenen tespitlerin dışında, Batman-Bingöl arası kuşbakışı mesafenin çok kısa olması ve Bingöl için öngörülen yaklaşık deprem büyüklüğünün 7.2 olduğu dikkate alındığında, Batman ilinin Bingöl depremine bir hazırlık olarak eğer gerekli tedbirler alınmaz ise yüksek oranda hasar alacağı öngörülmektedir.

Anahtar Kelimeler: 6 Şubat Depremi, Hasar Tespiti, Bingöl Depremi, Deprem.

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3 Boyutlu Yazıcıların İnşaat Sektöründe Kullanımı

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Özet

Son yıllarda 3 boyutlu yazıcı teknolojisi, farklı disiplinlerde kendine yer bulduğu gibi, inşaat sektöründe de önemli yeniliklere ve uygulamalara kapı açmıştır. Bu teknolojinin inşaat süreçlerine dahil edilmesiyle, maliyetleri düşürmek, inşaat hızını artırmak ve malzeme israfını minimize etmek gibi avantajlar sunmaktadır. Üç boyutlu yazıcılar, karmaşık yapıların hassas ve hızlı bir şekilde üretilmesine olanak tanıyarak, geleneksel inşaat yöntemlerine kıyasla daha esnek ve verimli çözümler sunar. Bu bildiri, 3 boyutlu yazıcıların inşaat sektöründe çeşitli alanlarda uygulanabilir kullanımlarını incelemektedir. Sonuç olarak, 3 boyutlu yazıcıların inşaat sektöründe geniş bir uygulama yelpazesi sunarak, sektördeki yenilikçi çözümler ve gelecekteki potansiyelleri ile önemli bir rol oynadığı vurgulanmaktadır. Bu teknolojinin yaygınlaşması ile inşaat sektöründe daha verimli, sürdürülebilir ve ekonomik projelerin gerçekleştirilmesi mümkün olacaktır.

Anahtar Kelimeler: 3 boyutlu yazıcı, 3 boyutlu inşaat, katmanlı üretim

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Investigation of the Effect of Replaceable Plastic Hinge Member on Different Types of Frames in Precast Reinforced Concrete Structures Using Abaqus Software

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Abstract

The demand for precast reinforced concrete (RC) structures is growing considering to their certain benefits, including faster assembly, homogeneous materials, and high-quality labor. The structural integrity of precast reinforced concrete (RC) constructions is influenced by both the quality of the precast components and the effectiveness of the joints and connections. This paper contains an analytical study about four type precast reinforced concrete frames which varies according to the number of storeys and the number of bays with two different type of moment resisting beam to column connection is investigated under cyclic displacement loading up to 5.6% drift rate by using ABAQUS software. The first connection type is the widely used moment resisting connection that is defined as wet connection in TBDY. The second connection type is known as Artificial Controllable. Plastic Hinge that is taken as reference study about replaceable plastic hinge concept. The goal of this connection, is to defend reinforced concrete components from earthquake related plastic deformations by keeping them in a specialized connecting section. It will be possible to repair the broken connections after the earthquake so the building can keep on operating normally. The cyclic behavior of the four type frame with the mechanical plastic hinge and wet connection were analytically investigated, and then comparisons and suggestions are made on period, ductility, structural system behavior coefficient. The analytical study shows that the replaceable plastic joint element provides a significant period increase. Especially in the case of two storeys and two spans, the change in period was felt the most compared to other frames. The results for ductility show a significant change in the ductility of the frames with replaceable plastic hinge. For the structural system behavior coefficient, a recommendation between 3.90 and 4.52 values was made.

Keywords: Precast structure, replaceable plastic Hinge, beam to column connection

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This article is extracted from my master thesis dissertation entitled "Investıgatıon Of The Effect Of Replaceable Plastic Hinge Member On Different Types Of Frames in Precast Reinforced Concrete Structures Using Abaqus Software ", supervised by Assoc. Prof. Reşat Atalay OYGUÇ (Master's Thesis Dissertation, Istanbul Technical University, Istanbul, Türkiye, 2024).

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Study of Vibrations of Frame Buildings as a Discrete Continuous System During an Earthquake Under Impulse Action

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Abstract

The issue of studying the effect of seismic impact caused by an earthquake as a shock effect on frame columns is presented. An analysis of the results of a strong earthquake is presented, in which the seismic shocks generated during the earthquake are considered to be the cause of the damage to the building. Both transverse and longitudinal oscillations are studied. In both cases, the existing analytical solutions are analyzed and the shortcomings they contain are noted. In both cases, the problems are solved numerically. Based on the results of the obtained calculations, displacement and force graphs are built. In the case of transverse impact, it is concluded that under the conditions of the existing construction of the columns, it is possible that the impact will cause the columns to be cut in the middle according to the height. It is given how to raise the issue and how to solve it. It has been shown that often the rupture patterns obtained as a result of seismic impact do not correspond to the inertial-oscillation theory currently in use. In such cases, the impression is created that the structure was affected by a short impulse in the form of a shock. i.e. It is necessary to consider the impact effect. It is mentioned here that the rupture scheme obtained according to the rigid-plastic model (eg in the case of Khoji) contains fundamental difficulties in solving the problem. It has been shown that often the rupture patterns obtained as a result of seismic impact do not correspond to the inertial-oscillation theory currently in use. In such cases, the impression is created that the structure was affected by a short impulse in the form of a shock. i.e. It is necessary to consider the impact effect. It is mentioned here that the rupture scheme obtained according to the rigid-plastic model (eg in the case of Khoji) contains fundamental difficulties in solving the problem. As a result of numerous observations, it has been established that at the initial moment of the seismic impact, most of the buildings collapse. Seismic impact instantly causes columns and walls of buildings to break so that the building does not even have time to start moving, i.e. To arouse the forces of inertia dangerous for him. It is known that during an earthquake, inertial forces are always preceded by the generation of transverse shear waves in the vertical elements of the building. Therefore, shear waves are primary and inertial forces are secondary. Therefore, it is natural to accept these waves as one of the main reasons for the collapse of buildings. Nevertheless, secondary inertial forces are considered to be the only universally accepted cause of seismic collapse today.

Keywords: Seismic resistance, buildings, dynamics, frame

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Changing of Reinforcement Prestress in the Frame-Link System under the Influence of Concrete Creep Deformations

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Abstract

As it is known in the end of the last century, Georgia and other seismically active regionshavesuccessfully implementedso-called Zhezheli 16-storey frame-panel residential buildings with bending armature under constructional conditions. Dozens of residential houses in Georgia are presented by such construction, which provide safe housing for millions of people. The building was constructed with prefabricated elements. the "Zhezheli" system is presented by a frame building in which the roofing foil from all four directions is held by the pre-pressured force of the armoured fittings that are strained between the columns; Straining of cables takes place on construction site. Study of unfinished construction; Investigation of the reliability of existing tense cables; Determination of tensioning values in concrete and armature; Assessing the reliability of the systemby determining breaking point of columns and tiles. The study and effects of changes pre-pressured strengths caused by long-term deformation of concrete.

• As a result of the research, conclusions and recommendations will be presented, according to which the construction of such type should be completed.

Scientific Novelty: Practical application of the completed work is important. Completion of semi-built buildings will provide the city with substantial residential place,thousands of people's requirements for accommodation will be met, namely refugees who are living in unbearable conditions of the dissertation discusses the nature and development characteristics of concrete's and reinforced concrete structurese's long-term deformation – creep. Those scientific studies related to the deformation of concrete due to creep. Creation and development of several scientists' creep theories are discussed in details, that state that deformation due to creep is a type of plasticity deformation. It develops due to long-term pressure. The development of concrete creeping deformation is especially important in pre-strained reinforced concrete structures, since the static scheme of construction, installation and work of operational elements is different, which results in unreliable results in assessing the system's tense-deformation state.

Keywords: *Concrete, prestress, creep deformation*

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Effect of Concrete Stress Model on Moment Bearing Capacity of Strengthened Reinforced Concrete Elements

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Abstract

Strengthening structures with inadequate seismic performance, provided that they are economical and safe, is important to reduce the loss of life and property that may occur. Strengthening is the process of increasing the existing bearing capacity of the element by eliminating the inadequate features of the element (shear, bending, etc.). In this context, the moment bearing capacity of the reinforced concrete element after it is strengthened with external wrapping (EBR) and/or nerar surface mounting (NSM) method should be calculated at the design stage and effective reinforcement details should be determined. One of the assumptions made in the bearing capacity calculation is the use of an equivalent rectangular compression block instead of the actual stress distribution of concrete in the calculation of the concrete compressive force carried by the section. Within the scope of the study, moment capacities of the test specimens available in the literature were analytically calculated. In the calculation of the bearing capacity of the section, the stress-strain curves of the concrete were first parabolic and then as an equivalent rectangular compression block. When the concrete compression block was parabolic, the concrete compressive force was determined according to the fiber method. In the calculations, the moment bearing capacities of the specimens were obtained and compared with the experimental results by taking into account the effect of TRM wrapped on the concrete compressive strength and the effect of CFRP plates on the moment capacity of the section. As a result of the study, the moment bearing capacities calculated according to both methods were obtained in accordance with the experimental results. The moment bearing capacities calculated according to the equivalent rectangular compression block are less compatible with the experimental results and are 1.44% to 3.48% lower than the capacities determined according to the parabolic compression block. In reinforced concrete elements strengthened with only the NSM method or with the combined application of NSM and EBR methods, where no reinforcement is applied, the concrete stress distribution can be used in both ways to determine the moment carrying capacities according to the fibrous or equivalent rectangular compression block methods.

Keywords: Strengthening, NSM, moment capacity, concrete stress distribution.

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Cost-Effectiveness and Performance Evaluation of Four Structural Systems: Framed, Shear Wall-Framed, Tube-in-Tube, and Outrigger in G+30 Storied Buildings Using ETABS

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Abstract

Reinforced concrete frames are the popular choice for high-rise buildings worldwide. Rapid urbanization has led to the construction of tall structures with more than 20 floors in cities. In urban high-rise construction, safety and cost-effectiveness are both important considerations. Innovative approaches are necessary to address these concerns. Modern structural systems, such as RCC, Shear Walls, Outriggers, and Tube-in-Tube systems, are now used. In this study, the performance of four structural systems in a G+30-story building has been analyzed using ETABS software. The study aims to evaluate these structural systems under seismic forces in Zone IV, considering wind pressure and seismic forces according to the Bangladesh National Building Code 2020. The research involves modeling and analyzing the systems with identical floor areas and building heights. Key parameters like base shear, story displacement, drift, stiffness, and cost-effectiveness have been studied. The Tube-in-Tube structure has the lowest beam deflection, while the Outrigger structure exhibits the lowest maximum story displacement and drift under seismic and wind loads. The Tube-in-Tube system experiences the highest story force, whereas the Outrigger system shows the highest base shear value, indicating superior lateral stability. Cost analysis shows that the RCC system is the most economical but has the highest displacements and lowest stiffness. In contrast, the Tube-in-Tube and Outrigger systems, while more expensive, offer better structural efficiency and lateral stability, making them more reliable for high-rise buildings. The study recommends the Tube-in-Tube and Outrigger systems for modern urban high-rise constructions due to their balance of safety and economy.

Keywords: Tall structures; Outrigger systems; tube structure; etabs; lateral stability

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An Improved Rapid Seismic Risk Assessment Tool for Existing Low to Mid-rise Reinforced Concrete Buildings in Türkiye

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Abstract

The vulnerability assessment of a large building stock rapidly and reliably is critical to use the time effectively for disaster management strategies before a major earthquake. This is generally achieved by performing detailed numerical analysis over analytical models. However, the number of buildings in an investigated region, a complexity level of numerical models, and the requirement of making quick decisions are considered as challenging issues in detailed assessment procedures. Thus, rapid and practical evaluation tools are also developed to prioritize the potential seismic vulnerability of buildings in a stock of interest. This proceeding presents a general framework of an improved rapid seismic assessment tool supported with a user-friendly interface. The tool is developed to help the experts make a preliminary decision about the potential seismic vulnerability of existing buildings using fundamental sidewalk survey parameters and structural components. Here, a two-level evaluation process is considered in the scope of a proposed framework. Specifically, a semi-secondary stage that requires more detailed information about the building (e.g., member and material details) is applied depending on a decision provided via widely used rapid visual screening methodologies. Details of the implemented theoretical approaches and input/output parameters are presented in scope of this paper. This assessment tool, which integrates primary level methods with the more conservative techniques (i.e., Anatolian approach), offers a user-friendly analytical tool enriched with numerical background and visual content. This tool is expected to be practical and useful in field applications, while also having the capability to meet the needs of municipal administrators.

Keywords: Rapid seismic risk assessment; vulnerability assessment; reinforced concrete buildings; prioritization of seismic risk.

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Önüretimli Betonarme Yapıların Kolon Kiriş Birleşim Bölgeleri İçin Literatür Araştırması

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Özet

Son yıllarda, yerinde dökme betonarme (BA) sistemlere kıyasla yapım tekniği, hızlı montajı, malzeme ve inşaat kalitesi gibi dikkat çekici özellikleriyle, özellikle endüstriyel amaçlar için birçok alanda önüretimli betonarme yapılar giderek daha fazla talep görmektedir. Önüretim teknolojisi, yapısal bileşenlerin farklı konut ve endüstriyel alanlarda farklı amaçlarla kullanılabilmesi açısından önemli avantajlara sahiptir ve bu yapım tekniği düşük karbon emisyonu ve sürdürülebilir özellikleriyle etkilidir. Saha araştırmaları, 6 Şubat 2023'teki Gaziantep ve Kahramanmaraş depremlerinden sonra önüretimli betonarme yapılarda çok ağır hasarlar gözlemlendiğini göstermiştir. Önüretimli betonarme yapım tekniği, olası uygulama hatalarını, nakliyeyi, yapısal bileşenlerin montaj kalitesini ve kontrol süreçlerini en aza indirmek için büyük bir fırsat sunmaktadır. Önüretimli yapılarda mafsallı veya moment aktaran bağlantıların montaj prensipleri çok dikkatli uygulanmalıdır. Zira, afet bölgesindeki endüstriyel yapıların incelenmesi, mafsallı bağlantıların uygulanmasında temel hatalar yapıldığını göstermiştir. Örnek olarak yetersiz pim uzunlukları ve çapları ile birleşim bölgesinde dolgu harçlarının yerinde uygulanmamış olması gösterilebilir. Uygulamada bu kadar iyi üretilmiş betonarme elemanların dikkatsizce birleştirilmesi çok ağır hasara neden olmuştur. Burada sunulan çalışmanın literatürde var olan hedefi sismik enerjiyi dağıtan ve montajı pratik, düşük maliyetli ve değiştirilebilir, sağlam, moment aktaran kolon kiriş bölgeleri için geliştirilmiş birleşim önerilerinin kuvvetli ve zayıf yönlerinin sergilenmesidir.

Anahtar Kelimeler: Önüretimli (prefabrik) betonarme binalar, değiştirilebilir sigorta tipi eleman, moment aktaran kolon-kiriş birleşimi, tersinir tekrarlı deney.

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Soil-Structure Interaction Effects on RC Building Retrofitted by Shotcrete Panels

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Abstract

This study investigates the effects of soil-structure interaction (SSI) on the seismic retrofitting of buildings. Specifically, it evaluates the performance of a two-dimensional structure strengthened by the addition of shotcrete panels, while systematically accounting for various soil types. Utilizing a nonlinear macro-element model for shallow foundation SSI, the study uses modeling parameters that reflect the unique characteristics of each soil class. Performance assessments are conducted through static push-over analysis and nonlinear dynamic time history evaluations via the SeismoStruct software. The analysis is focused on the Tuzla region, where soil conditions vary across soil classes ZA to ZD. A specific coordinate within this area was selected to represent the building's location, and the parameters for the analysis were determined based on this coordinate. Findings from the modal analysis indicate that SSI significantly prolongs the vibration periods of reinforced concrete structures compared to fixed-base conditions, particularly when the structures are situated on softer soils. Code-based capacity assessments reveal that many columns and beams reached their bending moment capacities in fixed-base scenarios on softer soil types, like ZD and ZC. Additionally, a small number of columns and beams also reached their shear force capacities. In contrast, good performance of retrofitted structure on ZB soil suggests that the retrofitting technique is effective. This analysis highlights the importance of soil improvement measures in regions with soft soils.

Keywords: Strengthening; soil-structure ınteraction; pushover analysis; seismic safety, soil types

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Multi-Camera Based Monitoring of the Structural Health of Historical Masonry Minarets

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Abstract

In structural health monitoring, vibration displacement response is commonly used to monitor the health status of engineering structures. Traditionally, the vibration displacement response of structures has been used to measure accelerations using physical sensors such as linear variable differential transformers (LVDT) and laser displacement sensors (LDS), or more commonly accelerometers. Traditional methods measure accelerations instead of directly measuring displacement due to some difficulties in the installation and implementation phase. Advances in engineering and technology have made it possible to overcome the challenges of traditional methods. Difficulties in direct displacement measurement have become overcome, with methods based on computer vision. However, sensitive image processing methods are needed to measure the vibration measurements of existing structures. In this study, the vibrations of a scaled model of a historical masonry minaret produced in a laboratory environment were obtained by camera-based monitoring and small movements in video recordings were detected by using optical flow algorithms. The scaled model was examined with simultaneous recording from four different points with camera-based monitoring. The results obtained in the videos were compared with the results obtained from accelerometers mounted in the same areas as the tracking points. With both methods, it is aimed to obtain the modal frequencies of the structure. Meaningful vibration signals could be obtained from this structure, which has movements that are too small to be seen with the naked eye. The peaks of these signals in the frequency domain correspond to the other data with which they are compared.

Keywords: Structural health monitoring; multi-camera-based monitoring; computer vision; optical flow; Lucas-Kanade method; historical masonry minaret.

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Structural Analysis of Plastic Voided Slabs

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Abstract

Today, the construction sector offers a variety of flooring options. In the context of large buildings, beamless floors are a popular choice, with void slabs emerging as a practical and innovative solution due to their lightness and openness. This study not only discusses the advantages, disadvantages, modeling, and cost analysis of void slabs but also provides practical insights for their application in comparison to other flooring types. Previous studies and results on the void slab were mentioned. The minimum heights, moment calculations, advantages, and usage areas of beam, flat, and waffle slabs are mentioned. This paper has created 560 numerical analysis models under five different moving loads in 16 different openings in the single and double directions in beam plate, void, gasoline, and waffle slabs. As a result, it was seen that void slabs were more advantageous as the amount of clearance and load increased. In conclusion, it is shown how a building with void slabs can be modeled using a safe program. Then, the shear strength, bending strength, punching strength, deflection values, and reinforcement areas are shown with graphs. The results are evaluated, and suggestions regarding the hollow floor are presented.

Keywords: Plastic voided slabs, flat slabs, punching, TEC 2018.

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Design Of Steel and Composite Columns with Loads Affecting Columns of Reinforced Concrete Building Models with Different Heights and Soil Classifications

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Abstract

Today, the design of building elements is evolving to meet the diverse needs of different structures. Reinforced concrete structures, which are used globally, including in our country, are designed to withstand tensile and compressive stresses. While the advantages of these structures in terms of calculation and production have made them popular, the variations in building needs have led to an increase in the dimensions and costs of these elements. In this paper, we present the findings from our study on the five and 13-story reinforced concrete models, which were constructed in 5 different ground classes according to the Turkish Building Earthquake Code. We calculated the loads affecting the columns using the Regulation on Design, Calculation, and Construction Principles of Steel Structures. These findings are crucial for understanding the behavior of reinforced concrete structures in different ground classes and can significantly impact future design practices. It aims to find the most advantageous solution when comparing a structure designed using new earthquake regulations in different column types and considering the changes that will be made in terms of engineering, architecture, and economy.

Keywords: Composite column, steel column, reinforced concrete colum, TEC 2018.

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Analytical Study of Structural Behaviour of RC Columns Strengthened with CFRP Wraps Under Axial Load

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Abstract

Strengthening of reinforced concrete (RC) members using Fiber Reinforced Polymer (FRP) composites has gained goodness in the recent years due to its various advantages. Reinforced concrete columns are normally subjected to axial or concentric loading and often need strengthening to increase their capacity and ductility. This study deals with how CFRP confinement affects the behavior and ultimate compressive strength of rectangular RC columns, which traditionally suffer from non-uniform stress distributions due to their shape. Nowadays many different models and mathematical equations have been proposed to obtain the compressive strength of CFRP confined concrete columns notably rectangular cross sections and focusing on different parameters of sections, material, shapes etc. In this paper various kinds of reliable models have been studied to calculate the acceptable value of confined compressive strength of concrete that wrapped or retrofitted with CFRP in under pure axial loads. The analysis results are compared with experimental data that has taken from literature and previous research to validate the model's accuracy. Sensitive investigation has been done to specify how changes in CFRP configurations affect the column's confined compressive strength and axial strain behavior. Also, concludes the analytical investigation of axially loaded columns that retrofitted by CFRP wraps and this research focused just on rectangular cross-sectional shapes. Results of analytical study that gained from different specifications are compared with the experimental data.

Keywords: Axial capacity, CFRP, ductility, column, strengthening

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Construction Management

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Evaluation of Monolithic Construction Quality According to the Economic Indicator

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Abstract

Based on the actual period of safe operation of the monolithic building, it is possible to determine the economic efficiency of the construction costs of the building. It is important for an investor when to spend money and when to receive income. Расходи и додошы must correspond to established terms. In connection with this, it is necessary to bring discounting - costs and benefits to one period - one moment of time. The yield index was used in the proposed method. When evaluating the building according to its economic indicators, the period of safe operation of the building, t.e. The time interval between the moment of construction of the building and the capital repair of the structure (the first life cycle of the structure). This approach is based on the fact that the term of safe operation of the construction is 50 years. The proposed method of evaluating the quality of a monolithic building can be used in practice as an instrument of the market mechanism of quality regulation.

Keywords: Monolithic construction, quality assessment, economic indicators discount rate.

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Digital Transformation of Construction Management with the Use of Automated Technology "Building Manager"

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Abstract

Automated technology of construction management "Building Manager" represents a groundbreaking advancement in construction project management, leveraging state-of-the-art automated technology to optimize efficiency, streamline processes, and enhance collaboration across all design and construction operations facets. Rooted in a comprehensive network of interconnected software solutions, automated technology "Building Manager" transcends traditional project management frameworks, offering unparalleled automation, information integration, and resource optimization capabilities. Automated technology of construction management "Building Manager" traces its origins to the innovative concept of "Automated Technology" (AT), a paradigm shift in project management facilitated by the symbiotic evolution of software systems. Originally conceived within the "Building Manager" software complex framework, this automated technology embodies a transformative approach to project management, characterized by its dynamic adaptability, robust information linkage, and relentless pursuit of construction management automation. Central to AT's "Building Manager" ethos is its ecosystem of interconnected software products, meticulously curated by diverse developers to synergistically operate within a unified framework. Integrating these disparate systems transcends conventional boundaries, facilitating seamless information exchange, standardized protocols, and enhanced interoperability. This collaborative endeavor culminates in realizing a cohesive, multifunctional platform capable of orchestrating complex construction projects with unparalleled precision.

Keywords: scheduling, resource management, construction management, project collaboration, on-site management, document management, mobile access and interoperability with a focus on BIM, automated technology of construction management, artificial intelligence, organizational and technological modelling of construction; BIM, Industry 4.0, Digital Transformation of Construction Management.

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Impact of the European Green Deal and Circularity on LEED Projects

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Abstract

Sustainability standards are changing in many industries, including the building industry, because of the European Union's comprehensive policy program known as the European Green Deal, which aims to achieve carbon neutrality by 2050. This study investigates the interactions between the policies of the European Green Deal and the requirements of the worldwide known LEED rating program for green buildings. In addition, the research examines how LEED standards are affected in order to meet Europe's ambitious environmental goals by examining important Green Deal components, including energy efficiency, the circular economy, and carbon neutrality. The study aims to investigate the impact of the European Green Deal and Circular Economy standards in terms of the building sector on the recently developed LEED version 5 (v5) criteria.

Keywords: European green deal; circular economy; LEED; green building certificate

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Geotechnical

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Kil Zeminlerde Konsolidasyon Süresinin Zeminin Kayma Mukavemeti Parametrelerine Etkisi

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Özet

Yumuşak kil zeminler, düşük kayma mukavemeti ve yüksek oturma potansiyeline sahip zeminlerdir. Çeşitli araştırmacılar yaptıkları çalışmalarda, zeminlerin konsolidasyon özellikleri ile zemin indeks özellikleri arasında ilişkiyi araştırmışlardır. Zeminin plastisite özelliğinin ve zemin sınıfının, konsolidasyon oturmalarında etkisinin büyük olduğu belirtilmiştir. Konsolidasyon zamana bağlı bir oturma olduğu için deneylerin zaman alması araştırmacıları istatistiksel yöntemlere yönlendirmiştir. Uzun süredir yapılan çalışmalarda zeminlerin granülometrisi, plastisite ve indeks özellikleri ile zeminlerin sıkışma parametrelerinin belirlenmesi üzerine çalışmalar yapılmış ve çeşitli bağıntılar oluşturmuştur. Bu çalışmada, farklı konsolidasyon basınçlarında konsolide edilmiş düşük ve yüksek plastisiteli kil zeminlerin kayma mukavemeti parametreleri ile ön konsolidasyon basınçları arasındaki ilişki araştırılmıştır. Likit kıvamda hazırlanan düşük ve yüksek plastisiteli kil zeminler 25 kPa, 50 kPa, 100 kPa, 200 kPa ve 400 kPa basınçlarında ön konsolidasyon basıncına tabi tutulmuştur. Konsolide edilmiş numunelerin serbest basınç, kesme kutusu ve veyn deneyleri ile kayma mukavemeti parametreleri kohezyon (c) ve içsel sürtünme açıları (ϕ) bulunmuştur. Çalışmada, düşük plastisiteli ve yüksek plastisiteli kil zeminler için yapılan serbest basınç, kesme kutusu ve veyn deneylerinden elde edilen verilerle kayma mukavemeti parametrelerini ön konsolidasyon basıncına bağlı olarak tahmin edebilen ve pratik amaçlar doğrultusunda kullanılabilecek bağıntılar ve grafikler oluşturulmuştur.

Anahtar Kelimeler: Düşük plastisiteli kil, yüksek plastisiteli kil, kayma mukavemeti parametreleri, ön konsolidasyon basıncı, yumuşak kil.

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Behaviour of Different Tunnel Cross Sections in Drained Clay-Siltstone Soils

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Abstract

In this study, different tunnel cross sections are modelled, in the same soil conditions to compare their behaviors for modelling Plaxis 2D program has been used. Soil was modeled using hardening soil model in the first layer and second layer which contain containing tunnel cross section is Clay Siltstone which was modelled using Hoek-Brown Model. Last layer which is Limestone is modelled using Hoek-Brown Model. In this study three different cross section of tunnel has been analyzed, Circular, Elliptic and Arched Tube. NATM method was to model these in plaxis. Results of deformed meshes, total displacements, axial forces, bending moments and shear forces that occur on tunnels are compared. As a results in arched tube deformed mesh and total displacement values are greater than elliptic and circular cross section. Between Elliptic cross section and circular cross section according to deformed mesh and total displacement there are no significant difference, but for axial forces, shear forces and bending moments some differences exist. Axial forces at elliptic cross section are more uniform distributed than circular cross section on the other hand elliptic cross section base is flatter than circular cross section for this reason axial forces in elliptic cross section base are higher than circular one. The higher axial load in base found in arched tube cross section as 42.99 kN / m. The most shear forces in both types occurred at the middle depth of the tunnel because of surcharge load on the tunnel. The most bending moments occurred at the middle depth of the tunnel in both types.

Keywords: NATM, Plaxis 2d, tunnel design, load distribution on tunnels, tunnel cross section.

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Reliability-Based Design Optimization of an Embedded Retaining Wall

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Abstract

This paper presents a comparative analysis of the influence of groundwater and seepage on the design of optimally designed embedded retaining walls demonstrated on a case study. The deterministic optimization model (OPT-ERW) contains an objective function for the minimum total length of the embedded retaining wall. The objective function is constrained by the design conditions and is later extended to consider the probability of failure as an additional constraint. The model was extended because the Eurocode 7 approach only partially accounts for uncertainties in the soil, while the reliability-based design (RBD) approach fully utilizes these uncertainties and to compare how seepage affects the reliability of the structure. A real coded genetic algorithm was used to obtain the optimal designs. The optimal designs obtained using the two different optimization models were further analyzed and it was found that when using the Eurocode 7 safety factor approach, the designs considering seepage have a higher probability of failure than the designs based on the RBD optimization. This suggests that the RBD method is more sensitive to seepage and could provide a more reliable design for an embedded retaining wall. The study also shows how the presence of groundwater and seepage affects the overall length of the embedded retaining wall.

Keywords: Embedded retaining wall; reliability-based design; genetic algorithm; optimization; seepage.

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Investigation of the Effects of Two Different Biopolymers on the Strength Parameters of Silty Soil

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Abstract

Soil improvement methods are commonly employed to enhance the load-bearing capacity of weak soils. Due to environmental concerns, traditional additives like lime and cement are increasingly being replaced by more sustainable alternatives. Recently, biopolymers have gained attention as environmentally friendly options for soil stabilization. However, combining biopolymers with additional agents to enhance bond strength is rare. This study investigates the effects of using Guar Gum and Xanthan Gum biopolymers in combination with calcium chloride ($CaCl_2$) on the strength parameters of silty soil. Biopolymers are known to form gel-like structures between soil particles, increasing strength. At the same time, calcium chloride interacts with the carboxyl groups of biopolymers, creating cross-linkages that further improve soil strength. In this research, biopolymers and calcium chloride were combined with silty soil and subjected to 7 and 28 days of curing. Unconfined compressive strength (UCS) and dcxirect shear tests were conducted, and the results were compared with reference samples. Changes in internal friction angle and cohesion were also analyzed based on different biopolymer ratios. The results demonstrated significant improvements in the strength of long-term cured samples, with calcium chloride enhancing the cross-linking effect of biopolymers. These findings suggest that biopolymers, in combination with calcium chloride, can be effective in environmentally friendly soil stabilization projects.

Keywords: Biopolymer; soil stabilization; xanthan gum; guar gum; cross-linking

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Effective of Magnesium Slag to Soil Stabilization in Clay Soils

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Abstract

Due to reasons such as rapid urbanization, rapid reduction of suitable settlement areas and excessive increase in building sizes, the need for floor improvement in the construction sector has increased significantly. In these cases, one of the solutions to be applied is to work with waste materials while soil improvement studies are carried out with additives. With the use of waste materials, the environmental pollution of these materials to nature, etc. it will be provided to be cleaned a little from harmful aspects. In this study, although there are multiple additives that can be used in soil improvement, magnesium slag, which is obtained from pure magnesium production and accepted as industrial waste, is mixed with the ground in certain proportions (5-10-15-20-25) in soil improvement and its strengths are measured in laboratory condition and its usability in soil improvement was investigated. The specimens were subjected to axial compression test, compression test and consistency limits tests. According to the test results, strength increases occurred with increasing additive ratios and it is predicted that the strength can increase even more in the long term. It was observed that the most suitable additive rates in terms of strength were minimum 15%.

Keywords: Magnesium slag, soil stabilization, clay soil, compressive strength.

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Usability of Magnesium Slag in Improving Granular Soils

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Abstract

Population growth around the world leads to an increase in the need for housing. Although the solid ground to be built on is decreasing, there is a lot of research on the improvement of unsound soils. The issue of the use of wastes generated as a result of industrial developments in soil improvement is important for the world agenda. The damage these wastes cause to nature and living things is very high. In this study, the usability of magnesium slag, an industrial waste, in soil improvement was investigated. Samples were prepared by adding 5%, 10%, 15%, 20%, 25% and 30% magnesium slag to the ground according to the maximum dry unit volume weight and optimum water content found in the standard Proctor test. The prepared samples were subjected to uniaxial pressure and permeability tests after being kept for curing periods of 1, 7, 28, 56, and 112 days. According to the test results, as the additive used increases, the compressive strength increases and the permeability decreases. Therefore, the use of magnesium slag gives positive results in soil improvement. By using the waste material, both the economy can be contributed and the damage to the environment will be reduced.

Keywords: Granular soils, stabilization, magnesium slag, compressive strength, permeability.

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Effect of Climate Change on Slope Stability Analyzes

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Abstract

The objective of this study is to determine the impacts of expected climate change on slope stability. For this purpose, A case study on slope instability in the Erkmen region of Afyon was selected. The stability analysis was performed considering the theory of rainfall infiltration and using Geo-Studio's SEEP/W module for the surface infiltration model of the slope. A parametric stability analysis of the slope was conducted to determine the importance of climate change on slope stability. Conditions for changes in volumetric water content, water permeability, porewater pressure, and groundwater flow are important. When soil permeability is low, the factor of safety decreases during rainfall events and on the days following, while when permeability is higher, safety increases after rainfall events. The effect of lower cohesion is nearly linear, with the factor of safety decreasing by 0.1 for every 1 kPa less cohesion. The increase in net infiltration of water may be the most critical factor for slope instability. The results of the analysis indicate that timely reduction of water net infiltration through planting and proper surface water runoff from the upper road and slope would be a relatively simple and inexpensive measure compared to the cost of remediating the landslide, considering expected climate change. Therefore, it is advisable to analyze all slopes with respect to the expected climate change, taking into account the potential impacts of climate change.

Keywords: Climate change, slope stability, rainfall infiltration, seepage analyses.

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Hydraulics

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An Investigation on the Mechanical Behaviours of Concrete Gravity Dam

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Abstract

Dams are large water structures built to meet various water needs of people. In addition to irrigation and drinking water, they also contribute to electricity generation. The planning of dam construction is crucial for the effective management of water resources. Due to their large size, detailed feasibility studies must be conducted before the construction of dams begins. After the feasibility studies, verifying the structural integrity of dams deemed suitable for the region through experimental studies is often impractical or costly. Instead of experimental studies, analysis programs frequently preferred for solving engineering problems are utilized today. In this study, the ANSYS program, which operates using the finite element method, was chosen. ANSYS is a powerful analysis program that combines many modules and provides an opportunity to examine problems under realistic scenarios. In this study, analysis were performed using the workbench interface of the ANSYS program. A concrete gravity dam, whose dimensions were provided and modeled accordingly, was examined. The dam was modeled in detail to create a realistic scenario. In addition to the dam's self-weight, displacement and stress values under water load were determined. The analysis were conducted considering that two-thirds of the dam was filled with water. The applied water load was modeled in accordance with fluid mechanics principles, impacting the structure. The displacement and stress values for the upstream side were examined and interpreted.

Keywords: Dam, workbench, finite element method, analysis

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Kızılırmak Basin Hydrological Drought Analysis

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Abstract

In this study, hydrological drought analysis was carried out with the Streamflow Drought Index (SDI) using data of two flow observation stations in the Kızılırmak Basin, which is the longest river that originates within Turkey's borders and flows into the sea within its own borders. Using monthly flow data between 1985 and 2015, 3-, 6-, 9- and 12- months SDI values were calculated and then drought severity and duration analysis was performed with Run Theory for these stations. As a result of the analyses, it was observed that station E15A038 had a longer and more severe drought than station E15A035.

Keywords: Streamflow drought index, run theory, Kızılırmak Basin.

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Mechanics

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Free Vibration Analysis of Shear Deformable Functionally Graded Porous Beams

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Abstract

The free vibration analysis of shear deformable functionally graded porous beams is investigated in this study. The modified rule of the mixture, which includes the porosity volume fraction represented by different types of porosity distributions, is used to express the continuous variation of the material properties of the SDFGPBs along the thickness direction. Additionally, hyperbolic shear deformation theory is used to characterize the kinematic relations of the shear deformable functionally graded porous beams, as well as Hamilton's principle is used to generate the equations of motion. Regarding the free vibration analysis of shear deformable functionally graded porous beams under several boundary conditions, a closed-form solution is established. Comprehensive comparisons with current data are performed in order to validate the formulation of the problem. The impact of porosity distribution patterns, span-to-depth ratio, power-law index, and boundary conditions on the values of the fundamental natural frequency of the shear deformable functionally graded porous beams are thoroughly examined.

Keywords: Free vibration; shear deformation; FGMs; porosity

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Finite Element Modelling of Hail Impact on Steel Sheets

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Abstract

This study investigates the indentation depths on steel sheets by dynamic hail impact experiments with simulated hailstones. The tests were conducted as pneumatic dynamic impact tests. The artificial hailstones were produced using PVA adhesive and demineralized water and liquid nitrogen. The study was then conducted on how these hailstones affected G300 steel sheets of different thicknesses. The study included theoretical experiments and finite element simulations. The accuracy of the finite element model was validated and proven through comparison with studies in the literature. A liquid nitrogen-produced artificial hailstone has similar structure and impact properties to a real hailstone. Artificial hailstones of three different diameters were made, and tests were conducted with these hailstones. Hailstones diameters are 38 mm, 45 mm, and 50 mm. According to the study, several factors contribute to the depth of the dents, including impact energy, the thickness of the sheet metal, and the diameter of the hailstone. While hailstones can vary in size, differences in momentum can result in similar permanent deformations. It is possible for a smaller hailstone with a higher momentum to cause a similar permanent deformation as a larger hailstone with a lower momentum while the impact energy remains the same. The ability to accurately predict dent depths under different hail impact scenarios depends on the understanding of these relationships.

Keywords: Finite element model, simulated hailstone, steel sheet, dynamic impact test.

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Solution of Elasticity-Based Modeling to Detect the Accurate Design of Nano-Composite with Control Sensing of Density

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Abstract

This paper investigated the vibration of chiral single walled carbon nanotubes based on modified orthotropic elastic shell model. The stress and strain equations are taken from Budiansky and Sanders (1963). This model contains both the effect of boundary conditions and height-to-diameter ratios. The wave propagation approach is engaged to written the governing equations in eigen form. This eigen form is solved through MATLAB software to obtain the fundamental frequencies of SWCNTs. The effect of boundary conditions and density for frequency behavior is discussed. The frequency pattern with two boundary conditions are seems to be parallel for chiral nanotubes. The frequencies decreased on increasing density. With higher index, the frequencies will be higher. The C-C frequencies are higher than those corresponding C-F condition. For shorter tube and shorter chiral index, the frequency displacement between the curves of C-C and C-F boundary condition is large. The author expects this frequency analysis for high frequencies in fascinating electromagnetic devices.

Keywords: Single walled carbon nanotubes; wave propagation approach; C-C frequencies; higher index; MATLAB software

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Bending Analysis of Functionally Graded Plates Resting on Elastic Foundations

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Abstract

This paper presents the bending analysis of functionally graded plates (FGM) resting on an elastic foundation. A new refined hyperbolic-exponential shear deformation theory (higher-order) is developed for static analysis of functionally graded plates resting on the Winkler – Pasternak type. In this theory, the proposed displacement field contains only four unknown variables, this new model satisfies the free traction boundary conditions on the top and bottom surfaces of the plate. The material properties are continuously varied through the plate thickness by the exponential form and sigmoid law. The governing equations are derived by the principle of virtual work and resolved by Navier solutions. The validity of this model is verified by comparing the obtained results with those found in the literature. It can be concluded that the present refined high-order shear deformation theory is accurate, simple and efficient for the bending of FG plates.

Keywords: Functionally graded materials; bending; plate; elastic foundation; navier solution.

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Optimization of Polymer Concrete Reinforcement with Palm Fibers and White Marble

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Abstract

This research focuses on optimizing the filler content using white marble powder with smooth specimens subjected to three-point bending. These same specimens were also used to evaluate the effectiveness of local vegetable fibers, particularly date palm fibers, as reinforcement for polymer concrete. For comparison, similar specimens were used to test polymer concrete reinforced with glass fibers. The results show that untreated palm fibers improve the strength and stiffness of the polymer concrete, making them suitable for use as reinforcement. However, treating these fibers with a NaOH solution weakens them, resulting in reduced strength.

Keywords: Composites; vegetable fibers; polymer concrete; surface treatment.

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Bending Analysis of Functionally Graded Polymer Composite Plates Reinforced with Graphene Nanoplatelets

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Abstract

This work presents the bending analysis of functionally graded multilayer graphene nanoplatelet (GPL)/polymer composite plates using the refined shear deformation plate theory. The GPL weight fraction shows a layer-wise change along the thickness direction, with GPLs uniformly dispersed in the polymer matrix in each layer. The effective Young's modulus of the nanocomposites is estimated through the Halpin-Tsai micromechanics model, while the rule of mixture determines the effective Poisson's ratio. Analytical solutions are obtained for the static deflection of the simply supported functionally graded GPL/polymer plates by using the Navier solution technique. Numerical results show that GPL distribution pattern, weight fraction, geometry, and size have significant influences on the bending behavior of the functionally graded GPL-reinforced nanocomposite plate.

Keywords: Functionally grade materials; polymer composites; the refined shear deformation plate theory; bending.

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Static Bending and Buckling Analysis of FG Beams Using A New Fifth-Order Shear and Normal Deformation Theory (FOSNDT)

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Abstract

A new fifth-order shear and normal deformation theory (FOSNDT) is developed for the static bending and elastic buckling analysis of functionally graded beams. The properties of functionally graded material are assumed to vary through the thickness direction according to power-law distribution (P-FGM). The most important feature of the present theory is that it includes the effects of transverse shear and normal deformations. Axial and transverse displacements involve polynomial shape functions to include the effects of transverse shear and normal deformations. A polynomial shape function expanded up to fifth-order in terms of the thickness coordinate is used to account for the effects of transverse shear and normal deformations. The kinematics of the present theory is based on six independent field variables. The theory satisfies the traction free boundary conditions at top and bottom surfaces of the beam without using problem dependent shear correction factor. The closed-form solutions of simply supported FG beams are obtained using Navier's solution procedure and non-dimensional results are compared with those obtained by using classical beam theory, first order shear deformation theory and other higher order shear deformation theories. It is concluded that the present theory is accurate and efficient in predicting the bending and buckling responses of functionally graded beams.

Keywords: Functionally graded beam, transverse shear deformation, transverse normal deformation, bending, buckling.

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Stability Analysis of CNT Reinforced Varying Cross-Section Bars Partially in Contact with Foundation

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Abstract

In this study, stability analyses of variable cross-section carbon nanotube (CNT) reinforced bars partially resting on the foundation are presented. Using the developed finite element formulation, critical buckling loads and mode shapes of variable cross-section bars where CNT is used in a matrix to improve mechanical, thermal and electrical properties are effectively determined. The effect of CNT reinforcement on the mechanical behavior of the structure is included in the formulation using the Halpin-Tsai approach. In this way, geometric parameters such as the thickness, length and diameter of the CNT reinforcement particles are used in the model. By examining the structural behaviors of the bars placed on the elastic foundation under different boundary conditions, the effect of the support condition of the structure on the stability is investigated for CNT reinforced variable cross-section bars. Cross-section changes in the bars are included in the model using different functions. In this way, the effect of variable stiffness and the effectiveness of the foundation parameters in the stability analysis of CNT reinforced bars are examined. In addition, the effect of the CNT ratio used in the bars on the stability behavior is revealed. The study allows the creation of an optimum design model by including the effect of different structural parameters on the stability behavior of the bars. The analysis results presented in this study contribute to the understanding of the stability behavior of CNT reinforced structures, which are dramatically used in various engineering fields such as aerospace, electronics, and bioengineering.

Keywords: CNT reinforced beam, finite elements, partial foundation, stability analysis, varying rigidity.

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Transportation

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From Keywords to Trends: Bibliometric Analysis of Artificial Intelligence Methods in Asphalt Pavement Research With R-Studio Program

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Abstract

Asphalt pavements are the most widely used pavement type in the world. There has been an increase in the use of artificial intelligence algorithms in the design and modeling processes of asphalt pavements. This study conducts a bibliometric analysis of the "asphalt pavement" keyword and its use in artificial intelligence models. Accordingly, 2544 articles in the English language in the Science Citation Index Expanded (SCI-E), Emerging Sources Citation Index (E-SCI), and Social Sciences Citation Index (SSCI) indexes were retrieved by searching the Web of Science (WOS) database, covering the period between 2000 and 2024. For the bibliometric analysis of the articles obtained, the R-Studio program was used to analyze the number of articles produced on an annual basis, the average number of citations per year, the most relevant journal analysis, the most cited journal analysis, the most relevant author analysis, the article production analysis of authors, the most relevant affiliations analysis, the country distribution analysis of corresponding authors, author-country-keyword triple match analysis, the most used word analysis, trend topic analysis, and co-occurrence analysis. The research findings were then evaluated.

Keywords: Bibliometric analysis, asphalt pavement, artificial intelligence, r-studio, web of science

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Improper Applications of the "Pedestrians First" Project of Antalya

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Abstract

As part of an earlier Joint-European (Leonardo-da-Vinci) project, a small number of pedestrian crossings in the city of Antalya, Turkey, during 2012 and 2013, had been altered so that pedestrians have always crossing priority at those particular locations. This alteration had been mainly in the form of road surface markings and/or signposts, both displaying the message of "Pedestrians First". The aim had been to create a more pedestrian-friendly and more liveable city. Initially, Akdeniz University had been a project partner [1], but later, the university was not involved in the rest of the stages. However, after the official completion of the actual project, over the past ten years, as one of the major outputs, the transformation of conventional pedestrian crossings to "pedestrians first" type crossings has been extended by the local authority to cover much bigger areas in the municipality. During these years, a huge number of pedestrian crossings has been transformed in this way, without sufficient and careful prior considerations and investigations with respect to the selection criteria of the crossings to be changed. In other words, after the handover of the scheme to the municipality, without taking into account road hierarchies, number of lanes, and operating speeds, etc., nearly all crossings in the city were made "pedestrians first" type crossing. This was probably because of misinterpretation of the whole idea behind the project by the practitioners of local authorities. No distinction is being made by these practitioners between low-speed urban streets with high pedestrian activities and high-speed major urban arterials with high vehicular volumes. This wrong and unsuitable applications resulted in many bizarre, problematic and potentially unsafe pedestrian crossings in the city. Examples include three or four lane major urban roads with these new type crossings, where traffic speeds easily reach well above 70-80 km/h, and where continuing is, as a matter of fact, 'safer' than stopping for pedestrians to cross. In addition to the safety risks, briefly mentioned above, these improper applications give rise to the problem of lack of compliance to traffic rules and signs. When drivers see these signposts of pedestrian priority, they, most of the time, feel obliged to continue, rather than to stop, as many other drivers too ignore these unrealistic and impractical signs and rules. This brings about the culture of incompliance and lack of trust. A third problem is that high traffic volumes on these major roads prevent drivers to stop for pedestrians to cross, because huge amounts of traffic congestions would be inevitable, and drivers are well aware of this undesired outcome.Therefore, the present paper will address this issue for the first time in the region after the implementation of the abovementioned project. The aim is

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to draw the attention of responsible authorities to the problem so that correct actions are taken before it is too late. Six example sites have been selected for the investigations to represent various road types and roads with various number of lanes. Two sites were two-lane roads (unidirectional), one site was a three-lane arterial (unidirectional), two sites were single lane streets, and finally one site was two-lanes in opposite directions with no central reservation. During these observations, parameters such as, (a) the size of the pedestrian group waiting to cross, (b) whether the vehicle stopped after seeing a pedestrian or pedestrians at the crossing, (c) the pedestrian waiting time at the crossing, (d) whether there was a platoon of vehicles approaching the crossing or only a single vehicle approach. The findings revealed that the rate of giving way to pedestrians varied from as little as 9% to 63%. Except two sites (one is very close to a hospital with many patient pedestrian population, and the other one is next to nostalgic tramway stop with many tourist and senior citizen population), at all remaining four sites the proportion of instances of compliance was below 25% out of all vehicle-pedestrian instances of meetings. Pedestrian waiting times changed from 4 seconds to as high as 18 seconds on average at these crossings, implying much higher values of single instances. The observations were also made to distinguish those vehicles that stopped with a harsh brake to give way to pedestrians and those vehicles that crawled down to a halt before the crossing.

Keywords: Pedestrian priority; pelican and zebra crossings; road safety; vulnerable road users

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Examination of the Properties of 70/100 Bitumen Modified with Activated Carbon

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Abstract

The volatile organic compounds are dispersed from asphalt fume to air during the construction of the pavement. This the volatile organic compounds negatively affect the environment and the health of workers. Activated carbon is used to improve bitumen properties and reduce effect of the volatile organic compounds. Activated carbon is obtained from biomass (hazelnut shell, coconut shell) and industrial wastes which have high carbon content. In this study, the effect of commercially activated carbon on the physical properties of 70/100 bitumen was examined. 70/100 bitumen was modified with commercially activated carbon at the ratios of 0.5, 1, 2, 3, and 4% with the help of a high-speed mixer for 1 hour at 2000 rpm and 150°C. Conventional bitumen tests (penetration, softening point and rotational viscometer) on bitumen modified with activated carbon was performed. Penetration index was calculated to determine temperature sensitivity of all modified bitumen. According to the obtained results, it is seen that as the activated carbon added to 70/100 bitumen increased, the penetration values of all modified bitumen decreased, while the softening point and viscometer values increased. Activated carbon which is added to 70/100 bitumen increased the stiffness of the bitumen. Storage stability was performed to determine performance of all modified bitumen at the high temperature. Since activated carbon which is added to 70/100 bitumen has little effect on the physical properties of modified bitumen, it is thought that the activated carbon ratios in bitumen modification should be increased.

Keywords: Activated carbon, bitumen modification, conventional bitumen tests, storage stability.

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Asfalt Çatlak Onarımında 3 Boyutlu Baskı Teknolojilerinin Kullanımı

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Özet

Asfalt yollarda görülen en yaygın bozulma türlerinden biri kaplama yüzeyinde oluşan çatlaklardır. Oluşan bu çatlaklara zamanında müdahale edilmediği takdirde çatlakların daha da derinleşerek asfalt kaplamaların hizmet ömrünü önemli ölçüde azaltabileceği bilinmektedir. Bu nedenle çatlak oluşumunda sorunların erken tespiti ve onarımı son derece büyük önem taşımaktadır. Geleneksel çatlak bakım yöntemleri, genellikle yoğun iş gücü ve zaman alıcı olup, yüksek maliyetler ve trafik aksamaları gibi dezavantajlara sahiptir. 3 boyutlu yazıcıların gelişimiyle beraber, geleneksel çatlak bakım yöntemlerinin yerine 3 boyutlu baskı teknolojilerinin kullanıldığı yenilikçi çatlak bakım yöntemleri geliştirilmeye başlanmıştır. Bu teknolojiler, daha hızlı, daha ekonomik ve daha etkili çözümler sunmaktadır. Bu bildiri, asfalt çatlak bakımında 3d yazıcı teknolojisinin nasıl kullanılabileceğini ve bu teknolojinin gelecekteki uygulamalar için potansiyelini ortaya koymaktadır.

Anahtar Kelimeler: 3D asfalt, asfalt bakımı, çatlak onarımı

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Investigation of the Effects of Using Waste Vegetable Margarine in Bitumen Modification

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Abstract

The use of various oils and their wastes in bitumen modification is quite common. In most of the studies in literature on bitumen modification, waste oils are used as rejuvenators and to soften hard neat bitumen or polymer modified bitumen. In this study, bitumen which has 50/70 penetration grade was modified with waste vegetable margarine at the ratios of 1, 2 and 3%. Physical properties of modified samples were investigated with the help of penetration, softening point, ductility and rotational viscometer tests. Penetration index values were calculated using the penetration and softening point test results to determine the temperature sensitivities of the samples. Moreover, stripping resistances and adhesion performances of them were investigated. Test results showed that the use of waste vegetable margarine results in an increase in the penetration and a decrease in the softening point. The temperature dependent susceptibility of the samples decreased as the additive ratio was increased. The rotational viscometer tests showed that both the mixing/compaction temperatures and ranges decreased as the additive ratio increased. In addition, it is possible to say that there will be a slight decrease in the stripping resistances of mixtures containing waste vegetable margarine modified bitumen. However, rising of waste vegetable margarine ratio in bitumen increased slightly adhesion performance. According to the results obtained, it was found that the modification with waste vegetable margarine can increase the resistance of bitumen to the conditions of cold climates by affecting the consistency.

Keywords: Waste vegetable margarine; bitumen modification; bitumen tests; stripping and adhesion.

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A Novel Structural Health Assessment Approach for the Ballasted Concrete Railway Sleepers

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Abstract

Concrete railway sleepers, one of the most common superstructure elements of modern ballasted railways, require effective Structural Health Monitoring (SHM) benchmarks that can be used during in-situ testing or remote monitoring. However, current or proposed techniques for detecting damaged sleepers are often complex, time consuming or unsuitable for field testing. This study investigates a novel approach that may overcome these challenges. This method uses the fundamental longitudinal resonance frequency as a benchmark of SHM. To date, researchers have generally focused on vertical, lateral or torsional mode shapes, which are highly sensitive to changes in ballast conditions and crack location/orientation. One of the main advantages of the novel approach presented is that the longitudinal resonance mode shapes are minimally affected by these changes, thereby increasing the reliability of the results. Damaged sleepers tested were found to have consistently lower longitudinal resonance frequencies, allowing cracked sleepers to be detected without the need to remove the ballast layer and carry out mandatory inspections/analyses. High repeatability was also observed on healthy sleepers, with deviations from the mean frequency not exceeding 0.5%. It was argued that this novel approach would provide a practical, rapid, and reliable means of in situ testing of concrete sleepers. Consequently, it is recommended that this approach be subjected to further validation through the implementation of more extensive in situ testing practices.

Keywords: Railway sleepers; Railroad ties; Structural Health Monitoring; Rail transportation safety; Experimental modal analysis; Naked eye crack inspection

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Investigation of Rheological and Chemical Properties of Bitumen Modified with Waste Engine and Industrial Oils

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Abstract

This study aims to investigate the reuse of waste oils (motor and industrial) in bitumen modification in order to ensure sustainable transportation. For this purpose, rheological and chemical properties of bitumen modified with waste oils were examined. Bitumen modification was completed by homogeneous mixing of each waste oil group with virgin bitumen having 50/70 penetration at a temperature of 140±5 °C and a speed of 1000 rpm for 30 minutes using a high-speed shear mixer. The modification process was repeated for five different ratios by weight of 2%, 2.5%, 3%, 3.5% and 4%. Penetration, softening point, ductility, specific gravity and rotational viscometer tests were conducted to determine the rheological performance properties of the modified bitumen. In addition, the chemical contents of virgin and modified bitumen were examined by Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM) and Energy Dispersive Spectrometry (EDS) analysis. The chemical content of waste motor and industrial oils was determined by Rotating Disk Electrode Optical Emission Spectrometry (RDE-OES). In order to assess the quality of the modified bitumen, the chemical and rheological results obtained for virgin and modified bitumen were compared with each other. According to the results obtained, the modified bitumen has a softer consistency compared to virgin bitumen. Consequently, it was concluded that modified bitumen may be used in cold climate regions. Additionally, the results of the rheological and chemical analyses were found to be consistent with each other.

Keywords: Sustainability; sustainable transportation; bitumen modification; waste oil management.

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Investigation of the Nylon Bag Waste Modified Bitumen Properties

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Abstract

Nylon bag wastes (NBW) serious environmental threats and is used in large quantities worldwide. This situation creates serious problems such as environmental pollution, damage to wildlife and micro plastic problems. Therefore, it is extremely important to reduce the use of nylon bags and to dispose of existing waste. The use of nylon bag waste in bitumen modification provides solutions to waste management problems and increases the performance of road pavement materials. In this process, nylon bags are cut into small pieces and mixed with bitumen. The resulting mixture provides more durable and long-service life road pavements. This modified bitumen is more resistant to temperature changes and reduces crack formation. In this paper, different rates of bitumen modification were performed with NBW, and the test results obtained by performing bitumen specific gravity, penetration, softening point, viscosity and Nicholson stripping tests on the samples were compared with the results of the control sample. As a result, it was assessed that the use of plastic bag waste in bitumen modification offers significant advantages both environmentally and economically, and this innovative approach is a promising method for the reusing of waste materials and the development of road construction technologies.

Keywords: Nylon bag waste; modified bitumen; bitumen test; sustainability.

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Rheological Behaviour of Bitumen Modified with Sustainable Additives: SBS, Animal Bones, and Waste Cooking Oil

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Abstract

The demand for sustainable, high-performance asphalt pavements has led researchers to explore new additives for modifying bitumen properties. This study investigates the effects of incorporating Styrene-Butadiene-Styrene (SBS), animal bones (AB), and waste cooking oil (WCO) into bitumen, focusing on key rheological properties: complex shear modulus (G*), phase angle (δ), and stiffness (G*/sin δ) at 15°C and 25°C. These properties are essential for designing durable pavements, especially in low-temperature conditions prone to cracking. Although SBS is a common bitumen modifier, there is limited research on alternatives like AB and WCO. This study aims to fill this gap by evaluating their impact on bitumen's rheological performance. Using a Dynamic Shear Rheometer (DSR), the study measures stiffness and elasticity across different angular frequencies. Results show that SBS significantly improves bitumen stiffness and rutting resistance. WCO-modified bitumen offers increased flexibility, while AB-modified bitumen provides a balance between stiffness and elasticity, suggesting its potential as a sustainable option. In conclusion, while SBS remains the most effective for enhancing mechanical properties, using waste materials like AB and WCO can promote more sustainable road construction practices, offering viable alternatives for future high-performance asphalt pavements.

Keywords: Bitumen modification; rheological properties; SBS; animal bones; waste cooking oil; sustainable pavements.

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Rail Thermal Buckling Risk Management: Comparative Analysis of Stress-Free Temperature Determination in the USA and Türkiye

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Abstract

Rail Thermal Buckling (RTB) is one of the most significant and growing risks to railway safety worldwide, driven by factors such as welded rail joints, high speed/heavy duty operations, 24-hour service, and climate change. To manage this risk, railway engineers rely on a key parameter known as Stress-Free Temperature (SFT). However, different railway organizations around the world use different approaches to determine SFT values. This study addresses this critical issue by examining the possible outcomes of practices in two different countries. The research uses data collected over the past three years at Wilmington Station, one of the rail and air temperature monitoring stations on rail lines operated by Amtrak (USA). Based on this data, SFT values were calculated according to the AREMA manual. In addition, a contrasting SFT value was calculated from the same data, based on the procedure used by TCDD (Turkish State Railways). Statistical analyses were then performed on the three years of rail and air temperature data using these two SFT values. The analysis showed that the SFT value of 41°C determined by the AREMA approach significantly reduces the RTB risk, with only 4.64% of all rail temperature data analyzed exceeding this SFT value. However, outside the summer months, this scenario is likely to result in higher tensile forces than the 24°C SFT value calculated using the second method, thereby increasing the risk of rail/weld failure.

Keywords: Railways; thermal buckling; heat related rail failure; data management; global warming

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Categorizing Urban Network Segments for Cyclists' Use for Multi-Objective Routing

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Abstract

This study develops a progressive navigation and guidance model for the route selection of cyclists. The route selection of cyclists is modeled as a Pareto Multi-Objective Optimization problem which is solved with the NSGA-II algorithm. The study aims to create safe, efficient and cyclist-friendly navigation tools to promote sustainable urban mobility. Data collection methods include GPS tracking, field measurements and qualitative approaches to understand cyclists' behavior and preferences. Nine objective functions are constructed based on criteria related to safety and comfort, incorporating decision variables related to cyclists' riding on sidewalks, capturing the complexity of urban cycling infrastructure. Tests are performed in a defined area in the center of Athens, Greece. The NSGA-II algorithm is executed with some modifications and the Pareto front is constructed, which consists of 28 alternative routes between two origin-destination points. The 4 routes that optimize the 9 criteria of the objective functions are presented, with most of the routes passing through the Zappeion Gardens. The NSGA-II algorithm is proven to be a suitable tool for application to a network with complex characteristics and for capturing cyclists' choices when they face conflicting choices. The most important contribution of the study lies in its innovative approach to modeling the optimization of cyclists' route choice, which considers a wide range of cyclists' needs and preferences.

Keywords: Bicycle; MOOP; pareto optimal; NSGA-II; route choice.

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Developing Public Transportation Information Systems at City Entry Points: Public Transportation Integration Score

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Abstract

This study aims to develop a metric as a scorecard for the current status of public transportation passenger information systems at city entry points (bus terminals, train stations, airports, and ferry docks). Field studies conducted in the cities of Bilecik, Bursa, Düzce, Eskişehir, Kocaeli, Sakarya, and Yalova evaluated the usage levels of spatial and online information systems. Additionally, the perceptions of public transportation users regarding these systems and expert opinions were analyzed using the Analytic Hierarchy Process (AHP). The study combined field observations, user perception analysis, and expert opinions, revealing that many cities have inadequate passenger information systems. In particular, smaller cities (Bilecik, Düzce, Yalova) were found to have significant deficiencies in both spatial and digital information systems. In larger cities like Bursa and Kocaeli, while more advanced systems were available, improvements were still needed, especially in terms of directional signage and digital integration. The user perception analysis indicated that these deficiencies hinder passengers' access to information and negatively impact passenger satisfaction. Expert opinions supported these findings, emphasizing the need for the digitization of public transportation systems and modernization of physical information systems. This study suggests that the integration of passenger information systems at public transportation hubs in Turkey should be enhanced. It is important to facilitate easy access to transportation information through advanced digital platforms, modernize physical information systems, and invest in infrastructure that strengthens the integration of intercity transportation. To improve the user experience, the scope of online information systems should be expanded, and external applications like Google Maps should be integrated with public transportation systems. Furthermore, experts recommend making public transportation infrastructure more inclusive and user-friendly.

Keywords: Public transportation, passenger ınformation systems, city entry points, ıntegration, user perception analysis

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Statistical Prediction of Bitumen Rutting Parameter

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Abstract

The loss of pavement serviceability is a common result from rutting which is defined as the formation of the longitudinal distress under the wheel paths caused by the progressive movement of materials under traffic loading in the asphalt pavement layers. In addition to aggregate skeleton, the rutting at high temperature can be attributed to the characteristics of bitumen used in asphalt mixtures. The convenience of different bitumen rutting parameters for evaluating the rutting resistance of unmodified bitumens as well as modified bitumens has been a trend topic of research for several years.
The scope of this study is to evaluate the estimation of bitumen rutting parameters and correlation ability with rheological test methods. For this purpose, following the evaluation of rutting parameters of various bitumen samples by different rheological test methods, oscillation, zero shear viscosity (ZSV) and multiple stress creep recovery (MSCR) test results have been correlated by statistically. ZSV and MSCR tests have been performed at different stress levels in creep mode. Beside, oscillation tests have been conducted at low (0.01 Hz) and high (10 Hz) frequency levels at five different temperature cycles ranging from 40°C to 80°C with 10°C increment by using of dynamic shear rheometer (DSR). Based on the rheological test results, the MSCR values have a good correlation with the ZSV values than with the G*⁄sinδ parameters. Therefore, it is recommended that the MSCR test be performed first in order to save time and obtain more accurate results in determining the bitumen rutting parameters.

Keywords: Rutting parameter; rheology; zero shear viscosity; multiple stress creep recovery; dynamic shear rheometer.

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Evaluation of Emergency Entry Maneuvers for Ambulances in Terms of Road Design: The Case of SDÜ Faculty of Medicine

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Abstract

One of the critical studies in urban transportation where accessibility and vehicle speed are the most important parameters in design is the planning of ambulance roads and entrances. In addition to the width, slope, turning angle and smoothness of road quality of ambulance passage and entrance roads, the speeds used in this design are also important in ensuring safety in planning. Because the speed parameter creates the maneuvering movement that affects all other parameters. Narrow entrance roads or sharp bends will make the movement of ambulances difficult. At this point, it is essential to have a separate ambulance entrance, especially for hospital entrances. The purpose of this study is to determine the problems that may be encountered in terms of traffic safety for the newly constructed SDÜ Faculty of Medicine Additional Building Intensive Care Unit and Emergency Polyclinic Ambulance entrance design and to evaluate these problems in terms of road geometry. The analysis results to be obtained will support safer entrance and driving for emergency vehicles in the future. AutoTURN simulation program was used to better understand the interaction between the road geometry in the study area and the maneuvering behavior of the drivers. The program is a software with the ability to easily produce complex maneuvers of the vehicles and developed in a CAD environment. This software includes the vehicle's trace on the road, which we can also call sweep analysis, and multi-body dynamic simulation. Multi-body dynamic simulation is a simulation that allows examining the balance of the vehicle while turning. The vehicle's curve angle, width and slope affect the vehicle's trace path while moving in a corridor. This method in the simulation program used in the study also reduced the overall simulation working time. This study has created a basis for the studies to be carried out to ensure safer ambulance passage and operation.

Keywords: Ambulance; entry road; speed; maneuver simulation

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A Comparative Investigation of the Effects of Geometric Differences in Weaving Areas in the United Kingdom and Türkiye

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Abstract

Weaving is generally defined as the intersection or overlapping of two or more traffic streams moving in the same direction along a given section of road. The study investigated the weaving problem as it occurs on the road networks of Turkey and the United Kingdom. New equations were proposed using optimization methods to calculate the average speed, average delay and average number of lane changes on the weaving sections in both countries. In Turkey there are often geometric problems that affect the complexity of the weaving sections. On the other hand, in the UK, unlike Turkey, the weaving problem was found to be caused by heavy traffic flow rather than geometry, and the weaving effect was found to be higher on the entry sections of modern non-signalized roundabouts. In addition, the backward shock wave created in modern roundabouts, which is located after the entry and exit in almost all entry/exit areas, brings the weaving problem to the fore. The results obtained by calculating the average speed, average delay and average number of lane changes using the proposed equations can be used to make the necessary operational adjustments to improve the weaving areas. If the values obtained are high, new geometric arrangements can bring them within the desired range. If there is no need for geometric regulation (UK example), solutions must be developed to regulate traffic flow. The study is a guide for both authorities and researchers on how to eliminate the confusion in the area of weaving.

Keywords: Average speed; delay; number of lane changes; weaving areas

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Demiroksit Pigmenti Kullanılarak Üretilen Renkli Bitümlü Karışımların Özelliklerinin Araştırılması

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Özet

Yol görünürlüğü ve okunabilirliği; özelikle trafik akışının ayrıldığı kesimlerde (bisiklet yolları, yaya yolları, yaya geçitleri, toplu taşıma şeridi vb.) ve tehlikeli alanlarda kullanıcılar için trafik güvenliği açısından önemli faktördür. Geleneksel asfalt kaplama (siyah renk) sıcak yaz günlerinde, yüksek miktarda gelen güneş ışınımını yakalama eğilimindedir. Bu durum asfalt kaplama üzerinde yüksek yüzey sıcaklığına neden olmaktadır. Kaplama sıcaklığının artması ile beraber ise kaplamalarda erken bozulmalar meydana gelmektedir. Erken bozulma aynı zamanda trafik güvenliğin de olumsuz etkilemektedir. Ayrıca bu sıcaklık artışı kentlerde kentsel ısı adasına sebep olmakta, bu da kentte yaşayanların sağlığı ve refahı üzerinde olumsuz etkiler yapmaktadır. Günümüzde, yol görünürlüğünü ve okunabilirliğini artırarak kullanıcı güvenliğini sağlamak, estetik karakter kazandırmak ve kaplama bozulmalarını azaltmak için renkli asfalt kaplamalar tercih edilmektedir. Bu yeni teknik ve politik farkındalık sayesinde, renkli asfalt kaplamaların büyük kamusal alanlarda kullanımı giderek yaygınlaşmaktadır. Bu çalışmada, demiroksit (Fe_3O_4) pigmenti kullanılarak üretilen bitümlü karışımların fiziksel ve mekanik performans özellikleri değerlendirilmiştir. Farklı demiroksit oranları ile hazırlanan renkli asfalt karışım numuneleri üretilmiş ve numuneler üzerinde Marshall dizaynı, Ultraviyole (UV) yaşlandırma sonrası renk özelliklerinin belirlenmesi, Cantabro kütle kayıplarının belirlenmesi ve güneş altında sıcaklık dağılımlarının izlenmesi deneyleri gerçekleştirilmiştir. Elde edilen sonuçlar, demiroksit katkısının kaplama performansını artırdığını ve yol görünürlüğünü olumlu yönde etkileyeceğini göstermiştir. Aynı zamanda bu çalışmada, yol yapımında demiroksit pigmentinin optimizasyonuna katkıda bulunması sağlanmıştır. Bu tür karışımların uzun dönem dayanıklılığı ve çevresel etkileri üzerine daha fazla araştırma yapılması gerekmektedir.

Anahtar Kelimeler: Bitümlü karışımlar; renkli asfalt; demiroksit (fe_3o_4); pigment; ultraviyole (uv) yaşlanma; kentsel ısı adası

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Investigation of Mechanical Properties of Basalt Aggregates in Terms of Use in Road Pavement

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Abstract

Recently, volcanic aggregates have become more favored in road pavement because limestone aggregates have shown weaknesses in durability. In this study, it is aimed to increase the level of knowledge about the physical and mechanical properties of basalt aggregates which is produced as crushed-stone in quarries. For this purpose, basalt aggregates with volcanic origin produced in quarries in Turkey were examined in terms of their physical and mechanical properties. The results were compared with the current specifications in force. As a result of the initial tests, it was determined that basalt aggregates have high impact resistance and high CBR values however flakiness index is also high. Based on the test results, it was determined that the findings obtained by single-graded and static test methods that are widely used for granular materials, do not provide sufficient information about the performance of materials in the mixture. In the study, statistically significant results were obtained by placing the resilient modulus findings into the K-θ model. Resilient modulus Mr(s) values obtained for basalt aggregates by the new K-θ formula are given in a table. Mr(s) values are the suggested stiffness values that can be used in pavement design in conditions where basalt aggregate is used as crushed-stone. As a result, it was determined that basalt aggregates had significant potential in terms of their usage in pavement layers instead of conventional aggregates such as limestone.

Keywords: Basalt aggregates; highway pavement; resilient modulus; mechanical properties.

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Development of a Distress Detection Index for Alligator Cracks on Highway Pavements

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Abstract

The most important component of transportation has been highways, which have been carrying all the services and commercial loads hence supporting the all economic activities. Therefore, quality of serviceability of highway pavement is crucially important for the sustainable highway transportation. In order to meet the necessary requirements of the pavement, frequent observation, appropriate maintenance and repair has to be done at the right time. In this context, this study was conducted regarding the observation of the most common and progressive alligator cracks, which is the most common and severe failure form of the pavement. An index was developed to evaluate the performance of asphalt-paved roads, focusing on these cracks in this study. Even on well-drained roads, uncontrolled increases in traffic load lead to the formation of cracks and subsequent water infiltration into the sublayers. Considering that the water in the sublayers creates temperature differentials that affect the upper layers, the analysis of these variables through thermal imaging is of significant importance. Conducted at Afyon Kocatepe University, the study processed data obtained from thermal imaging using software, determining a performance index by utilizing thermal and normal areas of the cracks and climatic impact coefficients. Alligator cracks were chosen due to their prevalence as the most common type of distress, representing the onset of pavement deterioration. The aim of the study was to provide support for visual data collection and non-destructive testing methods, allowing for a more objective assessment of pavement performance. In this context, a thermal observation procedure was formulated based on methods from the ASTM guidelines published in 2009, specifically in relation to the calculation of the Pavement Condition Index (PCI). Thus, the existing condition of asphalt-paved road segments was analyzed systematically by leveraging temperature differentials.

Keywords: PCI, distress, alligator crack, pavement distress detection

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Use and Advantages of Construction Waste Tires in Road Construction

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Abstract

In the construction industry, the use of waste tires in road construction attracts attention as an innovative approach that promotes environmental sustainability and offers economic benefits. In the study, the benefits of using waste tires in road construction will be examined. According to these results, reuse of waste tires reduces environmental pollution and contributes to the protection of natural resources. This practice minimizes negative effects on the environment by preventing large amounts of tires from going to landfills. Recycling tires and using them in road construction reduces costs. Compared to traditional materials, rubber additive materials can be more cost-effective, resulting in significant savings, especially in large-scale projects. Materials obtained from waste tires increase the crack resistance of road pavements, reduce wear and extend the overall road life. These materials are more flexible and resistant, especially to temperature changes, which reduces road maintenance costs. Rubber-added asphalt has sound and vibration absorption properties and provides a more comfortable driving experience for road users. The use of construction waste tires in road construction offers significant advantages in both environmental and economic aspects. This approach promotes sustainable road construction while also optimizing waste management and resource use. However, it is important to determine appropriate mix ratios for each application and conduct long-term performance evaluations.

Keywords: Asphalt pavement; waste tire; road strength; economy.

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Demiryolu Güzergah Planlanmasında Ahp-Topsis-Aras Yöntemi; Erzurum Örneği

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Özet

Osmanlı İmparatorluğu yıllarında 1856-1866 yılları arasında yapımı tamamlanıp açılan, 130 km'lik Aydın-İzmir demiryolundan sonra, demiryollarının ülkemizde 1950 yılına kadar gelişim gösterdiği, sonrasında karayolu ulaştırmasının gölgesinde kalması ile yolcu ve yük taşımacılığındaki payı gün geçtikçe azalmaktadır. Ulaşım planlaması gereken büyükşehirlerde araçların bölgelerarası geçişlerini, hizmet düzeyinde azalma olmadan yapabilmesi istenmektedir. Erzurum ilinin kent içinde toplu ulaşımı daha cazip hale getirip, sürdürülebilir bir ulaşım için kentin belirli bölgeleri arasına tramvay, hafif raylı sistem (HRS) veya metro yapılması kaçınılmaz olmuştur. Öncelikle çok kriterli karar vermede (ÇKKV), analitik hiyerarşi süreci (AHS) içinde ağırlıklandırmalar güzergâh uzunluğu, yakıt, zaman ve CO_2 kriterleri göz önüne alınarak yapılmış olup sonrasında karar verme yöntemleri olarak ideal çözüme benzerliği göre sıra tercihi tekniği (TOPSİS) ve Eklemeli Nispi Değerlendirme (ARAS) yöntemleri kullanılarak en uygun hat güzergahı belirlenmiştir. Tasarım aşamasında kent merkezinin mevcut trafik durumları göz önüne alındığında, insanların özellikle hastanelere kolay ulaşımını da dikkate alarak dört farklı güzergâh belirlenmiştir. Yapılan analizler sonucunda, topsis ve aras yönteminde en ideal güzergahın G-4 Hilalkent-Şükrüpaşa-Havuzbaşı-ETÜ-AÜ- Bölge Eğitim Hastanesi olduğu gözlemlenmektedir. Ayrıca ilerleyen yıllarda güzergâh belirlemede farklı parametreler ile farklı analiz metotları kullanılarak Erzurum ilinde yapılacak olan ideal kent içi karayolu ve demiryolu güzergahlarının tasarımına da yol gösterici ve sürdürülebilir olacağı düşünülmektedir.

Anahtar Kelimeler: Güzergah; demiryolu; Çkkv; tramvay; Hrs; metro.

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Geological Spatial Based Modelling for Economic Imperatives in Preliminary Site Investigation

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Abstract

Transport infrastructure is closely linked to several sustainability issues of main policy relevance, and significant impacts on geology as well as resource use and construction costs relate to the corridor design and location in the landscape. Urban geology provides information on urban geologic environments as a scientific basis for planners and engineers for rational land use planning and transport development. Such mapping can be classified in terms of purpose, content and scale. In this study, procedure for preparation of engineering geological mapping in Istanbul is given, as a case study. The main restricting factors for transport development: lithology; topography; slope were considered in the preparation of maps. Input layers were prepared using the Geographic Information System (GIS), and they were then combined to produce engineering geological maps. Results are illustrated as a suitability map for construction in the study area. Consequently, the study area was categorized into three different zones as: (1) least favorable area; (2) favorable area; (3) most favorable area. These segmentation offers a spatial representation of complex geological systems. The aim of this study was to develop methods for road planning and to discuss the imperatives (motivating reasons) that make it necessary to select areas for construction would be helpful demonstrating a more comprehensive analysis of the target region. For preliminary site investigation, digitized geological map can be used to plan effective field traverses that could enhance geological interpretations. This allows for delineating regions of interest and structural trends that may exist in the area. GIS Image pixel classification technique used to develop methods for road planning, in which corridor design and location would be based on geological sustainability criteria. improve the sustainability performance of transport infrastructure planning. A reclassification was performed for different the lithologic types that were converted to a raster layer and representative codes were assigned. This final map, which is easy to use, is a helpful document to decisions makers, engineers for optimum area extension. In addition to 'Geological suitable areas' for construction Seismic microzonation subdivides a region into individual areas having different potentials, hazardous earthquake effects, defining their specific seismic behavior for engineering design, landuse and urban planning. Microzonation is required to compile three essential components of seismology, geotechnical and structural engineering. This study focuses on the third component involves assessment of damage potential of roads in the region which is called as road vulnerability level. Road Structures such as viaduct, bridge, etc. a detailed site specific study is needed to be performed at each site during the design stage to evaluate the local site conditions. This study findings should be extended by site specific studies, including in-situ and laboratory tests in the assessment of required parameters for the structures with higher importance levels.

Keywords: Road structural engineeering; microzonation; engineering geological mapping.

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Comparative Analysis of Seismic Design Results for High-Speed Railway Bridges According to Different Standards

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Abstract

Although Türkiye is in a seismically critical region, studies on the standards for the seismic resistant design of bridges in our country are relatively new. The view that it would be appropriate to use the seismic design standards that are widely used in a region with similar seismic characteristics has been adopted for many years and AASHTO criteria, which is an American specification, has been used in the design of bridges and viaducts built in our country. In today's modern Türkiye, the number of high-speed railway projects is increasing, and therefore the share of railway bridges in all national projects is gaining importance day by day. Since designers in Türkiye have been more familiar with road projects for years, they tend to use American AASHTO standards, which is a road standard, in the design of new railway bridges. In this study, the applicability of AASHTO seismic design criteria to a high-speed railway bridge is analysed. In addition, the seismic design criteria of the DLH specification, which is the Turkish National Specification, were examined and a comparison was made on a sample bridge model in order to see the differences with AASHTO and its effect on the design of the bridge. In order to make this comparison, the sample bridge model was analysed for two different earthquake zones in Türkiye with the help of a computer program. This study gives clues about why the AASHTO specification has been preferred for years in the design of railway bridges in Türkiye.

Keywords: Earthquake design, high speed train bridge, AASHTO seismic design, DLH earthquake code

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The Impact of Technological Advances in the Transportation Sector on Sustainability

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Abstract

The impact of technological advances on sustainability in the transportation sector is increasing nowadays. This research examines the potential of technological innovations in the transportation sector in terms of environmental, economic and social sustainability by addressing the main points of this impact. Technological advances such as the transition to renewable energy sources, electric vehicles, autonomous transportation systems and smart logistics solutions contribute to important sustainability goals such as reducing greenhouse gas emissions, improving air quality and increasing energy efficiency. However, the spread and applicability of technological innovations depend on various factors such as infrastructure investments, political regulations and social acceptance. This study emphasizes the importance of technological advances in the transportation sector in terms of sustainability by highlighting some applications.

Keywords: Transportation, technological advances, sustainability, greenhouse gas emissions, electric vehicles, unmanned transportation.

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Improving Tunnel Safety through LED Lighting for Long Tunnels: A Driving Simulator Study

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Abstract

One of the problems of confusion in tunnels is that, in very long tunnels, vehicles break down and stop or wait in the tunnel. In existing new generation tunnels, when a vehicle stops in the tunnel, information is displayed on variable message signs at the tunnel entrances. However, in very long tunnels, the exact location of the stranded vehicle is not known, leaving drivers with a stressful journey in a confined space for many kilometers. This study has developed a solution to this problem for the Zigana Tunnel, which is the longest tunnel in Turkey and the third longest tunnel in the world. As part of the study, a red and green LED light system was placed on the tunnel ceiling sections in a vehicle simulator environment. For a scenario in which a vehicle breaks down and stops, the ceiling is illuminated with red light on this section of road, green light is switched on when the danger zone is passed, and then the existing bright tunnel lighting continues. In this context, the proposed scenario was tested with 50 different drivers in the vehicle simulator laboratory of Erzincan Binali Yıldırım University. From the results obtained, it was concluded that when drivers encounter such a problem in very long tunnels, indicating the problematic road section with red LED ceiling lights provides them with a stress-free and peaceful drive on other road sections in the very long tunnel. It has been found that drivers tend to reduce their speed on the sections of road with red lighting, move to the lane where driving continues and tend to obey the rules. It is predicted that this result can be effectively used in the new generation of intelligent tunnel operating technologies.

Keywords: Tunnel safety; lane-changing behaviour; driving simulator; zigana tunnel

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GIS-Based Analysis for Determining Hot Spots of Pedestrian-Involved Crashes

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Abstract

This study examines the spatial-temporal analysis of pedestrian-involved crashes in İzmir, Türkiye using Geographic Information System based analysis. As one of the most developed and densely populated cities, İzmir experiences a high rate of pedestrian accidents, making it a critical case for traffic safety analysis. Data from the İzmir Police Department reveal that between 2017 and 2019, a total of 6,794 pedestrian-involved crashes occurred, accounting for 15.7% of the total accidents in these years. After data cleaning and processing, the Kernel Density Estimation tool in ArcGIS Pro was employed to perform spatial density analysis and identify areas with high and low concentrations of these accidents. The study analyzed patterns of pedestrian-involved accidents by year and month to identify high-density crash areas within the core city. The results showed that while the number of pedestrians involved in accidents decreased over the years, the Kernel density estimation results indicated that the hot spot locations of the pedestrian crashes were not changed. April month was found as the highest number of accidents with 541 crashes, while January month was the lowest with 351 crashes. The lower number of accidents in winter can be attributed to people socializing less and being more cautious in bad weather conditions.

Keywords: Geographic information systems; kernel density estimation; pedestrian involved crashes; sustainable transportation

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The Effect of Modulus of Elasticity and Layer Thickness on the Design Life of Flexible Pavements

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Abstract

The Mechanistic-Empirical design method uses parameters such as wheel load, environmental effects and material properties to calculate stress and strain using basic material mechanics, and predicts the life of the road with these mechanical response values. For flexible pavements, predicting when pavement fatigue cracking and rutting will occur is a key indicator for determining pavement life. In this study, the effect of vehicle axle load, modulus of elasticity and thickness of pavement layers, which are directly related to the service performance of pavement is investigated using the Mechanistic-Empirical design method. In the calculations, a 3-layered flexible pavement system with linear-elastic behavior consisting of surface course, base course and subbase course on the subgrade is considered. By changing the values of wheel load, modulus of elasticity and layer thickness, 112 different scenarios were created and analyzed with KENPAVE program. As a result of the analyses, it was determined that the increase in the modulus of elasticity of the pavement layers has a significant effect on the pavement life and the increase in the modulus of elasticity of the base course contributes the main contribution to this effect. In the analysis using different layer thicknesses, the significant increase in pavement life was obtained by increasing the layer thickness of the surface course. It was determined that increasing the modulus of elasticity of the sub-base course did not have a significant effect on the increase in pavement life.

Keywords: Mechanical-emprical design, KENPAVE, fatigue cracking, rutting, pavement design life

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Investigation of Conductivity and Mechanical Properties of Electrically Conductive Asphalt Concrete Produced from Hybrid Aggregate

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Abstract

Icing on the highways causes some problems such as traffic accidents, delays, deteriorations and etc. Prevent of icing on the road pavement is divided into two as passive (traditional) and active (modern) methods. Traditional methods may not always be successful in preventing icing due to lack of icing consumables, equipment and personnel, environmental concerns, etc. This has necessitated the development of more effective, environmentally friendly, sustainable methods such as electrically conductive asphalt concretes (ECAC). In this study, there are two different ECAC groups, Series 1 and Series 2. Both groups contain carbon fiber as a conductive component and their aggregates consist of basalt in the coarse fraction, and limestone-based aggregates in the fine aggregate and mineral fillers. Series 1 samples were produced from virgin bitumen, and Series 2 samples were produced from bitumen modified with 14% carbon black (KT) used to increase electrical conductivity. To investigate the electrical conductivity properties of ECAC samples, volume resistivity measurement, thermal distribution measurement, ice melting performance and repeated freezing-thawing with electrical conductivity tests were performed. Then, to investigate the mechanical properties of ECAC samples, Marshall stability-flow, indirect tension and Cantabro tests (for raveling tendency) were performed. In addition, a comparative cost analysis was performed for ECAC and conventional asphalt concrete. As a result of the study, it was understood that the produced ECAC samples can be used in anti-icing, however, ECAC electrical conductivity properties are also affected by the type of mineral aggregate.

Keywords: Anti-icing, electrically conductive asphalt concretes (ECAC), hybrid aggregate, carbon black modified bitumen.

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Improving Intersection Efficiency: The Role of Right-Turn-on-Red (RTOR) Rule in Isparta, Turkiye

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Abstract

The right-turn-on-red (RTOR) rule permits vehicles to make a right turn after coming to a full stop at a red interval, helping to improve traffic flow and reduce congestion. Despite concerns regarding the safety of pedestrians and cyclists, this rule is implemented in many countries, particularly in the United States and Canada. RTOR rule was also recently implemented in Isparta, Turkiye to improve the efficiency of signalized intersections by reducing delays, fuel consumption, and the number of stops. In this study, the effects of RTOR rule at key signalized intersections in Isparta were analyzed, focusing on average vehicle delay and number of stops. The analysis was conducted at three busy intersections: Gülkent Intersection, Yeni Sanayi Intersection, and Peygamber Cami Intersection. The analyses utilized Synchro software, which enables both macro and micro-level simulations. The simulation results showed that right turns on red rule helped reduce congestion, decreased delays at certain approaches, and lowered the number of stops, which is a critical factor for fuel consumption. It is concluded that, thanks to the RTOR rule, delays on certain approach lane groups have decreased by approximately 5%, while the number of stops per vehicle has been reduced by around 25%.

Keywords: Intersection, delay, RTOR, signalization.

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Rutting Resistance in Basalt Fiber Reinforced Recycled Asphalt Pavement

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Abstract

Rutting is a critical aspect of asphalt pavement performance that influences safety, ride quality, structural integrity, load distribution, and economic considerations. Ensuring the effective management of rutting through proper design, materials selection, and construction practices is essential for the sustainability and functionality of asphalt pavements. Reclaimed Asphalt Pavement (RAP) is of paramount importance due to its environmental, economic, and performance benefits. The use of RAP conserves natural resources by reducing the need for virgin materials, cuts down on landfill waste, and lowers the environmental footprint of pavement construction. Enhancing rutting resistance with RAP and basalt fibers improves pavement durability and performance. This study explores the utilization of the Superpave volumetric design method to develop a reclaimed asphalt pavement (RAP) mixture. The percentage rates of RAP were 15%, 30%, and 45% respectively with an addition of 6 mm long and 3‰ basalt fiber. The Hamburg wheel tracking test was used to evaluate the mixture's resistance to permanent deformation. Results demonstrated a reduction in rut depth and surface peeling as the RAP content increased. Notably, asphalt mixtures containing 0% RAP and 3‰ basalt fiber exhibited lower rut depths compared to control samples. The experiments showed that RAP mixtures exhibit superior rutting resistance compared to conventional hot mix pavements. Moreover, the addition of recycled materials and basalt fiber significantly enhanced rutting resistance. Future research may focus on evaluating the crack resistance of asphalt pavements reinforced with high tensile strength basalt fiber.

Keywords: Basalt fiber, rutting, permanent deformation, reclaimed asphalt pavement (RAP)

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Using Asphalt Pavement Instead of Ballast and Subballast Layers in Rail Track

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Abstract

Railway transportation is one of the most reliable and economical transportation types when appropriate conditions are provided. Today, the increasing traffic load and traffic density in road and air transportation has caused the railway, which can transport more passengers and freight in a short time, to regain its popularity; This situation allowed the investments in the sector to increase. Expectations from a railway track; keeping its vehicles safe against leaving the track, absorbing the horizontal and vertical forces of the vehicles, transferring these forces gradually, and not compromising the comfort of the trip while ensuring these. In parallel with the developing technology, research and development studies on the construction and maintenance methods used in High Speed Railway tracks and conventional tracks continue. Other factors such as reserves of the materials used, accessibility, design of the track and cost have made it possible to use ballastless structure instead of ballasted structure in many countries. Among these, the most preferred alternative material for ballast is asphalt. In this study, the advantages and disadvantages of using asphalt in the ballast layer and/or subballast layer with ballasted structure; Basic differences such as design of the track, strength and durability, cost analysis, and lifetime are compared.

Keywords: High speed railway, subballast layer, ballast layer, bituminous mixtured layer, FMA.

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Intervention Mapping for Traffic Crashes in Türkiye

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Abstract

Traffic crashes are a significant public health issue in Türkiye, with a road fatality rate of 7.67 deaths per 100,000 inhabitants, accounting for approximately 1.2% of total deaths. This study explores the application of the Intervention Mapping framework to design structured, theory-based interventions aimed at reducing traffic crashes in Türkiye. Using crash statistics, the research identifies high-risk behaviours, including speeding and driving under the influence of alcohol, as key contributors to fatal crashes, particularly during the summer months and nighttime. This study applies the Intervention Mapping process to engage multiple stakeholders, such as public institutions, educational organizations, and international bodies, in developing targeted interventions. These interventions include enhanced speed control, stricter enforcement of traffic laws, public awareness campaigns, and shifts in social norms surrounding risky driving behaviours. The PRECEDE-PROCEED model is utilized within this framework to systematically identify and address the factors contributing to traffic crashes. Furthermore, the approach emphasizes the importance of a multidisciplinary collaboration to ensure that the interventions are contextually relevant and sustainable. The findings suggest that structured, evidence-based interventions tailored to Türkiye's unique traffic environment can effectively reduce traffic-related fatalities and injuries. This research contributes to the field by offering a comprehensive approach to improving road safety and promoting behavioural change in drivers, ultimately aiming for long-term impact on public health outcomes.

Keywords: Traffic crashes; intervention mapping; behavioural intervention; precede-proceed model; road safety

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Water Resources

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Investigation of Mediterranean Region Precipitation and Temperatures with Innovative Polygon Trend Analysis

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Abstract

Climate change has significant impacts on hydro-meteorological variables such as precipitation, temperature and evaporation, which are key components of the water cycle. Increasing air temperatures due to global warming increase the amount of evaporation, which in turn affects the hydrological cycle. Precipitation is vital for water supply, agricultural irrigation and socio-economic development, and its variability is associated with threats such as droughts and floods. Therefore, knowing precipitation and temperature trends is very important in prevention strategies against natural disasters such as droughts and floods. In this study, the trends of precipitation and temperature variables in the Mediterranean Region were determined by innovative polygon trend analysis (IPTA) method. The study utilized monthly average precipitation and temperature data for the years 1981-2022 for the provinces of Isparta, Burdur, Antalya, Mersin, Adana, Hatay, Osmaniye and Kahramanmaraş. The results revealed that precipitation and temperature variables in the Mediterranean Region show different seasonal and monthly trends. While precipitation increases in January and September, it generally tends to decrease in spring and fall. Temperatures, on the other hand, mostly tend to increase. Increases in precipitation, especially in January and September, can increase flood risk, while overall temperature increases and decreases in precipitation increase drought risk. These findings are critical for understanding the regional impacts of climate change and for the sustainable management of water resources.

Keywords: Innovative polygon trend analysis, Climate change, precipitation, temperature, Mediterranean Region

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Using Machine Learning Algorithms with Over Sampling Techniques for Sediment Transport Prediction

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Abstract

In this study, using data from three stations of the Kızılırmak River (Yamula, İnözü and Avşar), data imbalances were eliminated and the performance of machine learning models was improved with methods such as random oversampling (ROS) and synthetic minority oversampling technique (SMOTE). Firstly, models were developed with Ada Boost, Random Forest, Extra Tree, Gradient Boosting, XGB, LGBM and Gaussian Process algorithms using the original data sets. XGB algorithm showed the highest performance at Yamula station, Gradient Boosting algorithm at İnözü station and Ada Boost algorithm at Avşar station. Then, the imbalances in the data sets were eliminated by using ROS and SMOTE techniques and hybrid models were created with new data sets. The results showed that the models developed with SMOTE did not improve the performance at Yamula and Inözü stations, but provided a significant increase at Avşar station. In the models developed with ROS, Gaussian Process at Yamula station, Extra Tree at Inözü station and XGB at Avşar station showed the highest performance. These results indicate that ROS-ML models can be used effectively in the prediction of river sediment transport.

Keywords: Innovative polygon trend analysis, climate change, precipitation, temperature, Mediterranean Region

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Water Polders: A Tool to Mitigate Climate Change

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Abstract

The issues of water scarcity and extreme weather events represent significant challenges that are being exacerbated by climate change, which is a further complicating factor. The efficacy of conventional flood control methods is increasingly being questioned, particularly in light of the growing necessity to protect vulnerable regions. The phenomenon of climate change presents a considerable challenge to the global water system, affecting both the quantity and quality of water resources. The concept of Water Polders, derived from historical practices, represents a novel approach to the management of water resources. By strategically transforming low-lying areas into controlled reservoirs, it is possible to enhance resilience and adapt to changing climate conditions.

The present study is focused on the Middle Oder region, with particular attention paid to the Milsko floodplain. The retention of polders has been demonstrated to significantly reduce the risk of flooding in downstream areas during periods of heavy rainfall. The selective flooding of specific areas within the polder serves to enhance the overall retention capacity and improve the efficiency of the water management system. The retained water serves as a valuable resource during periods of low precipitation, supporting the security of water supplies and irrigation needs.

Water polders represent a comprehensive solution that integrates engineering, hydrology, and ecological principles. By harnessing their potential, we can mitigate flood risks, enhance water availability and safeguard ecosystems. In the context of a changing climate, water polders represent a source of hope and a testament to human ingenuity and our commitment to a water-secure world.

Keywords: Water retention; floodplains, climate change; adaptation to clime change; Odra river.

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İçme Suyu Dağıtım Şebekesinde Basınç, Hız ve Yük Kaybı Değişkenlerinin Farklı Sayısal Yöntemler ile Adana İli Örnek Uygulamaları Üzerinden Modellenmesi

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Özet

İçme suyu dağıtım şebekelerinin bilgisayar destekli modelleme süreçlerinde birçok programdan faydalanmak mümkündür. Her programın uygulanması noktasında avantaj ve dezavantajları olmakla beraber geleneksel hesap yöntemleri ile yapılacak mukayese çalışmaları doğruya yakın modelleme aşamalarına olumlu katkılar sunabilecektir. EPANET bahsedilen bu yazılımlar arasında yaygın bir kullanım alanına sahiptir. Bu çalışmada Adana ili içerisinde nüfus ve topoğrafik koşullar açısından iki farklı mahalle yerleşimindeki su dağıtım şebekelerinin EPANET ile modellenmesi amaçlanmıştır. Değerlendirme ölçütleri olarak basınç, hız ve yük kaybı gibi hidrolik parametreler ele alınmış olup, inceleme alanı ise Aladağ- Başpınar ve Kozan- Gazi Mahallesi şebekeleri şeklinde seçilmiştir. Öncelikle nüfus projeksiyonları belirlenmiş, devamında ihtiyaç debileri hesaplanmıştır. Dağıtım sistemleri depo haricinde düğüm ve boru bağlantıları şeklinde modellenmiştir. Söz konusu program kullanılarak elde edilen sonuçlar klasik bir hesap yöntemi olan Ölü Nokta Yöntemi ile karşılaştırılmış, sonuçlar grafik ve tablolarla yorumlanmaya çalışılmıştır. Örnek uygulamalar tek zon şeklinde ele alındığından hidrolik değişkenlerin sonuçlarının her iki çözüm sonuç açısından da benzer olabileceği öngörülmüştür. Elde edilen sonuçlarda anlamsal düzeyde ilişkileri değerlendirebilmek adına regresyon analizleri gerçekleştirilmiştir. İlaveten 24 saat zaman süreçli şebeke hidrolik değişim analizleri yapılmış, ilgili grafikler program aracılığıyla oluşturulmuştur. Çalışma sonucunda en yüksek korelasyonun basınç verilerinde olduğu görülmüştür. Hız ve yük kaybı parametreleri düşünüldüğünde ise birtakım farklılıkların olduğu dikkat çekmektedir. Başpınar Mahallesi uygulaması için her iki yöntem ile ulaşılan sonuçların tatmin edici yakınsama sağladığı düşünülmekte, ancak Gazi Mahallesi çıktıları için R^2 değeri oldukça düşük değerlerde kalmıştır. Bu sonuçlarda arazi yapısının engebeliliği ve uygun vana uygulamalarının etkili olabileceği düşünülmekte, ilerleyen zamanlarda kayıp-kaçak oranları ve su kalitesi konularında çeşitli çalışmalara değinilebilecektir.

Anahtar Kelimeler: EPANET, ölü nokta yöntemi, hidrolik karşılaştırma, Başpınar ve Gazi Mahalleleri

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Temporal Analysis of Drought at the Uludağ Meteorological Station, Bursa, Türkiye

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Abstract

Unlike other hydrometeorological disasters, drought develops slowly over long period. Analyzing changes in droughts over time in Mediterranean climate regions, which are expected to be affected by climate change, is important for water resources management and planning. In this study, the determination of important dry periods on the monthly precipitation data of Uludağ meteorological station located in the mentioned region and their changes over time were analyzed. Standardized Precipitation Index (SPI) was used to determine droughts between 1970-2019. The accumulation period of 1, 3, 6, 9 and 12 months from meteorological to hydrological drought was determined. To determine trends of major droughts and their severity duration intensity characteristics over time, the innovative trend analysis (ITA) method based on SPI=−1 value was preferred. A long dry period occurred between 1985-1990 and 2016-2020. Among these dry periods, 2017 has reached a very severe drought. 2010-2011 and 2014-2015 are the wet periods. As the accumulation period increases, the severity and duration of drought increases but the intensity decreases. According to the ITA, it was observed that drought increased in all accumulation periods, but only in the 12-month accumulation period, wet values increased as well as drought. When monthly trends are analyzed, different trends emerge according to the months. There is a significant increase in the severity, duration and intensity values of drought at high values. In general, it can be said that the non-monotonic increase in droughts and its characteristics will challenge water resources management and planning.

Keywords: Climate change; drought; innovative trend analysis; standardized precipitation index

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