



EFFECTS OF ECCENTRICITY ON DISPLACEMENTS OF SEISMIC ISOLATOR

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The idea of a seismic isolation relies on providing a rigid movement to superstructure by burdening all the translational displacements on the seismic isolators. There are certain variables that affect the performance of the isolator. One of them , which is studied in this project deeply , is eccentricity . A three storey structure which has 35 seismic isolators is utilized to be analyzed with the favour of a structural analysis program called OpenSees under bi-directional excitations . In analysis , while the other parameters are kept constant , %5 %10 and %20 eccentricity is applied on the superstructure to observe the amplifications of displacements with regard to non-eccentric case.

At the end of the study , the results indicated that the amplification of maximum isolator displacements (MID) is directly related to eccentricity of the superstructure . The relation may be described as an increase on MID as the eccentricity of the superstructure increases.



**EFFECT OF Q/W RATIO ON THE MAXIMUM ISOLATOR DISPLACEMENT OF A MASS
ECCENTRIC ISOLATED STRUCTURE**

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In this study, the effect of characteristic strength, Q , to weight, W , ratio on the amplification of maximum isolator displacements is studied on a typical mass eccentric isolated structure. For this purpose, several nonlinear response history analyses are conducted. In these analyses, bi-directional ground motion excitations are subjected to idealized structural model. Accordingly, both horizontal components of ground motion records are applied to the model simultaneously. Isolation units are composed of Lead Rubber Bearings (LRBs). They are modeled by a deteriorating hysteretic representation in which the lateral strength of LRB reduces gradually due to rise in temperature of lead core. To solely focus on the effect of Q/W ratio, isolation period T and eccentricity ratio are kept constant. The analyzed structure is a 3-story building with 35 isolators. Analyses are performed in Earthquake Engineering Simulation Program, OpenSees. In the analyses, near-field ground motions are used and scaled in accordance with code provisions. Results revealed that amplification in MIDs of a mass eccentric isolated structure is not sensitive to change in Q/W ratio. Also as a result of analysis of maximum isolator displacements for different Q/W values, it is confirmed that increase in strength of isolator, make reducing effect on MID.



**KAZIKLI RADYE TEMEL TASARIMI ve PETROL PLATFORMU
TEMELİNİN MODELLEMESİ**

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Kazıklı radye temeller, taşıma kapasitesi düşük olan zeminlerde üst yapı yüklerinin sağlam zemine ulaştırılmasını sağlayan bir temel sistemdir. Kazıklı radye temeller oturmaların sınırlandırılmasını, temelin taşıma gücünün artırılmasını ve eğilme momentlerinin istenilen seviyede tutulmasını sağlar. Araziden alınan numuneler ile yapılan laboratuvar çalışmalarında zemin tabakalarının durumu, yer altı su seviyesi ve zemin tabakalarının parametreleri belirlenmiştir. Zemin etüd raporu ve geoteknik değerlendirme raporunun hazırlanmasından sonra zemin taşıma kapasitesinin düşük olması nedeniyle kazıklı radye temel tasarımı yapıldı. Oturmanın izin verilebilir değerden yüksek olduğu göz önünde bulundurularak kazığın soketlendiği zemine jet-grout uygulaması yapılmış ve zemin parametreleri iyileştirilmiştir. 1200 m² oturma alanına sahip iş merkezi için yapılan temel tasarımda 15 metre uzunluğunda 80 cm çapında 46 adet kazık kullanılmıştır. Analizlerde üst yapı için Sta4Cad, temelde ise Plaxis 2D kullanılmıştır. Yapılan çalışmalar sonucunda yapıdan gelen yüklerin zemine güvenli bir şekilde aktarılması sağlanmıştır.

Ayrıca, kaldıraçlı petrol platformlarının temeli olarak deniz zeminlerinde kayma, ezilme kuvvetlerine ve oluşan momentlere karşı dirençli olan spudcan temeller araştırılmıştır. Prototip spudcan temel modellemesi yapılmıştır.



**ECONOMICAL RUN-OF-RIVER PLANT CAPACITY DESIGN
IN THE MOUNTAINOUS CATCHMENT (CASE STUDY-B)**

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Electricity demand is a major issue for developing technology and increasing consumption. Renewables (e.g. solar, wind, hydropower, biomass and geothermal) are essential carbon free resources against environmental pollution and global warming. Since selection of a proper power plant capacity is a key factor, an economical installed capacity is determined and the productivity of a run-of-river hydropower plant is investigated in this study. Flow data are taken from one of the stream gauge stations in the Upper Euphrates river basin. Main structures (intake, forebay tank and power house) are located on the topographic maps. Firstly, the firm energy is calculated as 22 GWh for 98 % flow exceedance of flow duration curve. On the other hand, optimal installed capacity of 36 MW which corresponds to 107 GWh annual energy obtained from the cost analyses (considering energy selling prices, investments and interest rates) and flow characteristics. Optimal design flow is determined as 72.1 m³/s (%30 of the flow duration). The lifetime of the project is selected as 40 years and 2.5 years equity payback period is obtained according to cash flow diagrams. As a result, (benefit-cost)/investment ratio is calculated as 3.16 indicating a feasible project for run-of-river hydropower plant.



**CHANGE IN MAXIMUM ISOLATOR DISPLACEMENTS SUBJECTED TO SCALED
GROUND MOTIONS WITH DIFFERENT ORIENTATIONS**

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Seismic isolation is one of the most effective ways of protecting the structures from devastating effects of ground motions. Among various seismic isolators, lead rubber bearings (LRBs) are the most widely used isolator units. In this study, a structure isolated by means of LRBs are studied under the effect of bidirectional excitations. Selected ground motions are representative of near-field records and scaled to represent two different seismicity levels namely, design based earthquake and maximum considered earthquake. In order to quantify the amount of amplification in maximum isolator displacements of LRBs due to change in orientation of ground motion, selected as-recorded ground motions are rotated through 180° with intervals of 10°. Furthermore, to find the effect of isolation period on this amplification, four different isolation periods are also considered as a parameter. The force-deformation relation of LRBs are represented by hysteretic behavior in which the strength of LRBs deteriorate under cyclic motion. That deterioration in strength is a function of lead core heating. The analyses results revealed that the maximum isolator displacement increases up to 2% due to rotation of original record compared to its as-recorded counterpart. Same observation is valid for seismicity levels of both DBE and MCE. Also, isolation period is found to be an ineffective parameter in terms of amplification in isolator displacement when different orientation of motions is of concern.



Effects of Staircases on the Seismic Performance of Reinforced Concrete Buildings

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There are many factors resulting with failure in the frame members or collapse of the whole building during the earthquakes. The staircases are a significant factor affecting the seismic performance of reinforced concrete buildings. Staircases are very critical in the evacuation of people after earthquakes. The main effects of the staircases are briefly; short column effect, torsional effect, staircases increases the seismic demand of the frame structures combined to stairs. In general, the landing of the stair carried by a beam located at the middle level of the storey and this causes to short column effect on the columns connected to that beam. Stairs increases the rigidity of the structures, and if the stair is not located symmetrically, it changes the location of the rigidity center of the structure and this will cause a torsional effects during earthquakes. Also, as mentioned above, stairs have a considerable rigidity and this increases the seismic demand of the stair during the earthquakes. That seismic demand affects the stair and the frame members connected to stair in a bad manner, and this effect may cause failures in the frame members, if their capacity is inadequate to support the seismic loads.

The energy dissipation of the structural members resulting with the non-elastic deformations under lateral loads is called as plastic hinges. The plastic

hinge formation in the reinforced concrete structures is crucial. In this study, the project has been conducted to observe and determine the structural members in which the plastic hinges seen initially, and to determine the degree of the effects of the staircases on the seismic performance of the reinforced concrete buildings. A four storey building has been analyzed by using SAP2000 software program. Analysis has been completed with structural models with no-stair , and stairs at different locations. After the analysis, the effect of the staircases have been seen as it is mentioned above. To prevent the building failure caused by staircases, shear walls have been located symmetrically on the structural plan of the building.

The study shows that the staircases should be considered during the design process, and symmetrically located shear walls decreases effects of the staircases on the reinforced concrete buildings.



**HYDROLOGIC MODELING OF GÜVENÇ BASIN
USING HEC-HMS MODEL**

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The need for water increases day by day in a society. While water should be used efficiently for domestic, agricultural and energy requirements, precautions should be taken for excess water that may cause flood inundation. In this respect, the objectives should be to conduct proper hydrologic and hydraulic designs at certain locations using measured data for the planned water structures.

In this study, geomorphologic basin characteristics are determined using GIS for a pilot drainage basin representing Central Anatolia. Afterwards, rainfall-runoff relationship is simulated in the basin by applying HEC-HMS model on event basis. Several different storm events are replicated in order to find model parameters for the basin and modeling performance is measured with various goodness-of-fit criteria.

Keywords: Hydrologic Modeling, GIS, HEC-HMS, Güvenç Basin



COACH STATION PROJECT DESIGN,STATIC ANALYSIS AND THREE-DIMENSIONAL MODELLING

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In accordance with the transportation needs increasing day by day and, a coach station is designed for the city Zonguldak. Considering that Zonguldak is a maritime city, the coach station is designed in the shape of an anchor. The project is modelled in ideCAD program.This program is checking to stability of the structure. As the structure is massive, it is separated from each other with dilatations and analyzed in five different mass in the program. The station project is modelled as three-dimensional with Google Sketchup program.



DIVERSIFICATION STRATEGIES IN CONSTRUCTION FIRMS

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Diversification is a strategy that takes a company into new markets with new products or services. Companies may choose a diversification strategy for different reasons. *Firstly*, companies might wish to create and exploit economies of scope, in which the company tries to utilize its existing resources and capabilities in other markets. This can oftentimes be the case if companies have under-utilized resources or capabilities that cannot be easily disposed or closed. Using a diversification strategy, companies may therefore be able to utilize all its capabilities or resources, and able to attract new business from market segments not catered to earlier. *Secondly*, managerial skills found within the company may be successfully used in other markets, where the dominant logic and managerial procedures of management can be successfully transferred to other markets. *Thirdly*, companies pursuing a diversification strategy may be able to cross-subsidize one product with the surplus of another. This way, companies with a very diverse portfolio of products catering to different markets may potentially grow in power, and be able to withstand a prolonged period of price competition etc. When having subsidized one product for a substantial period of time, the company might possibly be able to win a monopoly, making it the only supplier in the respective market. *Fourthly*, companies may also want to use a diversification strategy to spread financial risk over different markets and

products, so that the entire success of the company is not reliant on one market or product only. As a research method, it is created and used questionnaire which is about diversification strategy in the construction industry. There are 21 questions for surveying to ask to some kind of engineers , architects, company owners, business faculty students etc. To understand and to get informations of the reasons of diversification strategy in construction firms , whole answers of survey was collected in google forms and analyzed SPSS program .



HYDROLOGIC ANALYSIS OF UPPER ARAS BASIN

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Construction of water structures is necessary to supply water for domestic, agricultural and energy requirements as well as to prevent floods. To determine the dimensions of every hydraulic structure, hydrologic design is the first step.

In this study, Geographic Information Systems (ArcGIS) platform is used to derive basin geomorphologic characteristics (area, elevation, slope, aspect, landuse) of Upper Aras Basin, a transboundary river with headwaters in Turkey.

As the next step of the hydrologic phase; hydro-meteorological data are gathered and examined for several water years. These data are temperature, precipitation, evaporation, snow cover days obtained from State Meteorological Services and discharge data collected by State Hydraulic Works.

Since headwater of the Aras River is located in a mountainous region, snowmelt dominates runoff especially in spring and early summer months. Monitoring the change in snow extent is most efficiently done by satellite remote sensing. Snow and Ice Mapping Systems (IMS) satellite images are evaluated along 150 days in year 2009 to derive snow depletion curves of the basin under study.

Keywords: Hydrologic Analysis, Geographic Information Systems, Remote Sensing, Aras Basin



**EFFECTS OF BEAM DISCONTUNITY IN THE
PERIMETER FRAMES ON SEISMIC PERFORMANCE OF RC BUILDINGS**

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Because of Turkey is in the active earthquake area and living earthquakes have revealed with adverse effect results, important development have been made in education and science fields. With confessing regulations and standards have been forced for the decreasing the probable earthquake damages for at least. Most of the RC buildings have been designed with architectural console which caused generally beam discontinuity around the perimeter column in Turkey. Architectural console is an important factor which causes irregularity of structure. So far, the effects of architectural console have been studied by various researchers and it enables profitable and more reliable having projects for designers. In this project, the effects of seismic behaviors of beam discontinuity of perimeter column for frame structural have been studied. Beam discontinuity of perimeter column can form weak frames on the structural carrier system. When the beams don't tie between perimeter columns, because of the column are kept by just slab for one direction, the displacement of perimeter columns increase. As well, disconnecting of frame perimeter columns with beams decrease rigidity and strength of structure about 40 percent is revealed by previous researchers. Because of these reasons, resolving of frame perimeter beam discontinuity which usually originated from architectural console has important place in seismic behaviors of structure and performing of beams enable more steady and reliable structures in the earthquake areas for designers.

Within this framework, firstly I have designed a having 1.5m console and five floors regular structure on STA4Cad program. After that, I also designed it SAP 2000 program to analyze. For using Sap 2000 program, reinforcements and loads are taken from STA4Cad program. In Sap 2000 program, I have analyzed four models which are noninclusive shear wall beamed model, beamless model, inclusive shear wall beamed model and beamless model. For observing the inelastic behavior of structure, I used nonlinear time history and static pushover analysis. Seven bi-directional earthquake

ground motion records are selected and scaled for nonlinear time history analysis. As a result of analysis, displacement, accelerations and shear forces at each time steps can be obtained. Inter floor drift ratio, pushover capacity curve and story of shear forces are viewed to determine the strength and having displacement of building for all cases.



E-BIDDING APPLICATIONS IN TURKISH CONSTRUCTION INDUSTRY

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Technology is increasingly used in the bidding process of the construction sector in order to reduce the associated costs of bidding. In this respect, e-bidding is employed to facilitate the exchange of information and the submittal of prices in an electronic format by a construction client, general contractor(GC), or sub-contractor. The main aspects of e-bidding that may appear in a typical construction project are dissemination of information related to project, specifications, standards and agreement, preparation and submittal of an invitation to bid, pricing and receipt of the completed bids.



**ECONOMICAL RUN-OF-RIVER PLANT CAPACITY DESIGN
IN THE MOUNTAINOUS CATCHMENT (CASE STUDY-A)**

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Renewables to meet human electricity demands are growing carbon free sources and 64 % of clean energy is still provided by hydropowers in worldwide. This study aims to design an economical installed capacity for a run-of-river hydropower plant. A sub-basin (which corresponds to 25% of monthly discharge) from one of Upper Euphrates River located in Eastern part of Turkey is selected as a case study area. Firstly, an average annual energy is calculated as 80.45 GWh from 25% exceedance probability for 20.53 m³/s average flow according to flow duration method. Secondly, 74.36 GWh annual energy is determined according to the economical method if an optimum installed capacity would be selected as 12 MW with design flow of 17.15 m³/s. In the design, the components (intake, power house etc.) of the run-of-river hydropower plant are located in topographic maps and the net head is selected as 79.3 m. Also a Francis turbine is proposed in relation to the net head-discharge values. While flow-duration method is directly based on average of flows, the economical method takes into account both the flow characteristics and cost-benefit parameters (investment costs, interest rates, selling prices etc.). As a conclusion, the profit breakeven point as 5.5 years for 35 years of lifetime project is calculated with cash flow diagrams, and (benefit-cost)/investment ratio is 1.33 indicating a feasible project for run-of-river hydropower plant.



**HYDROLOGIC MODELING OF GÜVENÇ BASIN
USING HEC-HMS MODEL**

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The need for water increases day by day in a society. While water should be used efficiently for domestic, agricultural and energy requirements, precautions should be taken for excess water that may cause flood inundation. In this respect, the objectives should be to conduct proper hydrologic and hydraulic designs at certain locations using measured data for the planned water structures.

In this study, geomorphologic basin characteristics are determined using GIS for a pilot drainage basin representing Central Anatolia. Afterwards, rainfall-runoff relationship is simulated in the basin by applying HEC-HMS model on event basis. Several different storm events are replicated in order to find model parameters for the basin and modeling performance is measured with various goodness-of-fit criteria.

Keywords: Hydrologic Modeling, GIS, HEC-HMS, Güvenç Basin



Quantitative and Qualitative Analysis of Widely Used Research Techniques

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This thesis is focused on the research techniques that has been used for research in different fields of study specially the department related in Construction Management and Civil Engineering. The research methodology and techniques has always been effected on the outcomes and their applications. The article is about the mixed methods of research to emphasizing the reflexive and iterative nature of qualitative data, and the relational aspects of knowledge construction of quantitative data.

Using the data from different journals (Journals of Civil Engineering, Journal of Architecture, Journals of Construction Management, Journal of Safety Research, International Journal of Project Management, Journal of Construction Engineering and Management, Journal of Management in Engineering, Canadian Journal of Civil Engineering, Construction Management and Economics etc.) between the period of 2005-2015 and analyze the data with different software and doing statistical tests like NOVA, t-test, chi-square etc. to check the trends of research techniques, the latest techniques that are used nowadays, making a brief presentation by using illustrations like graphs and tables etc.

ABSTRACT

Graduate Project

DETERMINE THE MECHANICAL PROPERTIES OF FLY ASH BASED GEOPOLYMER CONCRETE

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2016

Fly ash based geopolymer concrete produced by using fly ash, aggregate, alkali solution and superplasticizers. In geopolymer concrete, sodium hydroxide and sodium silicate was used as alkali solution. The advantages of geopolymer concrete are high strength, very low creep, resistance to hot and cold and also chemical resistance. On the other hand, the disadvantages are hard to make and lack of uniformity. The geopolymer concrete is using in such areas; retaining walls, bridges and dams. The types of geopolymer concrete are calcium, phosphate, organic, and rock based geopolymer concretes are exist.

In this study, fly ash is used for the mineral admixture. The amount of fly ash is obtained as 750 kg / m^3 . The ratio of Alkali solution / Fly ash is taken as 0,40 0,55 and 0,65. Alkali solution ; Sodium Hydroxide / Sodyum Silicate is taken as 2,5. The ratio of water / geopolymer binder is taken as 0,05 – 0,10 and chemical admixture is used %0,5 - %1 amount of alkali solutions. Geopolymer concretes are produced as dimensions of 10x10x10 for 3 and 28 days. According to TS EN 12350-1, TS EN 12390-1, TS EN 12390-2 or TS EN 12504-1 compressive test and TS EN 12504-1 splitting tensile test are applied. Produced samples are waited 60 – 80 °C in drying oven for 48 hours. After that the samples are put in the curing tank.

According to the experimental results, if the amount alkali solution increases, the compressive and tensile splitting strength increase. The highest compressive strength obtained from which has the ratio of Alkali solution / Fly ash using as 0, 55. If the temperature of curing increases , the compressive and tensile splitting strength of geopolymer cocnrete increase.

Keywords : Fly ash, Sodium Hydroxide, Sodium Silicate, Compressive Strength, Splitting Tensile Strength

ÖZET

Lisans Bitirme Tezi

UÇUCU KÜL ESASLI GEOPOLİMER BETONUN MEKANİK ÖZELLİKLERİNİN BELİRLENMESİ

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Uçucu kül esaslı geopolimer beton, uçucu kül, agrega, alkali çözelti ve gerekirse süperakışkanlaştırıcı kullanılarak üretilen bir beton türüdür. Geopolimer betonda alkali çözelti olarak sodyum hidroksit ve sodyum silikat kullanılır. Geopolimer betonun yüksek dayanım, çok düşük sünme ve büzülme, sıcak ve soğuğa karşı direnç ve kimyasal direnç gibi avantajları bulunur. Geopolimer beton avantajlarının yanında bazı dezavantajlara da sahiptir. Yapımının zor ve zahmetli olması, üretiminin içerdiği kimyasallar nedeniyle ve betonda bulunan uniform eksikliği geopolimer betonun dezavantajları olarak söylenebilir. Geopolimer betonun kullanım alanları; istinad duvarları, barajlar ve öngermeli köprülerdir. Kalsiyum, fosfat, organik maden, kayaç ve metakaolinit esaslı geopolimer beton türleri de vardır.

Bu çalışmada geopolimer beton üretiminde mineral katkı olarak uçucu kül kullanılmıştır. Uçucu kül miktarı $750 \text{ kg} / \text{m}^3$ olarak alınmıştır. Alkali çözelti / uçucu kül oranı ise 0,40 0,55 ve 0,65 olarak alınmıştır. Alkali çözelti; sodyum hidroksit / sodyum silikat oranı 2,5 alınarak hazırlanmıştır. Karışımlarda su / geopolimer bağlayıcı oranı 0,05 - 0,10 ve kimyasal katkı %0,5 - %1 oranında kullanılmıştır. $10 \times 10 \times 10 \text{ cm}$ küp boyutunda üretilen 3 ve 28 günlük betonlar TS EN 12350-1, TS EN 12390-1, TS EN 12390-2 veya TS EN 12504-1 'e göre basınç deneyi ve TS 12390 – 6 'ya göre yarmada çekme deneyi yapılmıştır. Üretilen numuneler 48 saat $60 - 80 \text{ }^\circ\text{C}$ kür koşullarında bekletilmiştir. Kür koşullarında sonra numuneler kür havuzuna bırakılmıştır.

Deneysel sonuçlara göre geopolimer betonda kullanılan alkali çözelti miktarı arttıkça basınç ve yarmada çekme dayanımlarının arttığı belirlenmiştir. En yüksek basınç dayanımı Alkali çözelti / Uçucu kül oranı 0,55 olan numunelerde elde edilmiştir. Kür sıcaklığı arttıkça geopolimer betonun basınç ve yarmada çekme dayanımının arttığı gözlenmiştir. **Anahtar Kelimeler:** Uçucu Kül, Sodyum Hidroksit, Sodyum Silikat, Basınç Dayanımı, Yarmada Çekme Dayanımı

ÖZET

Lisans Bitirme Tezi

KARMA ÇELİK LİFLİ BETONUN ŞEKİL DEĞİŞTİRME KAPASİTESİNİN BELİRLENMESİ

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Beton, gevrek ve çekme dayanımı düşük bir malzemedir. Geleneksel betonun bu özelliklerinin iyileştirilmesi için yapay lifler beton üretiminde kullanılmaktadır, ilk çatlak oluşumu ve yayılmasını geciktirmekle birlikte çatlak sonrası davranışını iyileştirmektedir. Çelik lifli betonlar süneklik ve tokluk özellikleri geleneksel betona göre fazla olan beton türleridir.

Bu çalışmada, çelik lif katkılı betonların şekil değiştirme kapasitesi incelenmiştir. Bu amaçla 15x30cm, 6x15cm, 10x10x50cm boyutlarında beton numuneler üretilmiştir. Kiriş numunelerde RILEM deney yöntemine göre 0.5x 40mm çentik oluşturulmuştur. Karışımlarda 420 kg/m³ PÇ 42.5 R çimento ve %10 oranında silis dumanı kullanılarak S/Ç= 0.40 alınmıştır. 30 ve 60 mm boyutundaki lifler 20 kg/m³, 40 kg/m³, 60 kg/m³ olmak üzere 3 farklı miktarda kullanılmıştır. Her farklı lif miktarında 30 mm boyutundaki lifler toplam lif miktarına %100, %85, %70 oranında kullanılmıştır. Farklı boyutlarda üretilen 28 günlük numuneler üzerinde TS EN 12390-3'e göre basınç, TS EN 12390-6'e göre yarmada çekme ve RILEM TC 50-FMC'e göre çentikli kiriş deneyleri yapılmıştır. Silindir numunelerde TS 12350'ye göre ultrasonik dalga hızı deneyi uygulanmıştır.

Deney sonuçlarına göre, betonda çelik lif kullanımı arttıkça işlenebilirliği önemli oranda azaldığı gözlenmiştir. Çelik lif kullanımının lif oranının artması ile birlikte betonun kapasitesi şekil değiştirme kapasitesi ve tokluğunu arttırdığı belirlenmiştir. Çelik lif kullanımı ile eğilme dayanımında da önemli bir artış gözlenmiştir

Anahtar Kelimeler: Karma Çelik Lif, Şekil Değiştirme Kapasitesi, Basınç Dayanımı, Yarmada Çekme Dayanımı

ABSTRACT

Graduate Project

DETERMINATION OF THE DEFORMATION CAPACITY OF HYBRID STEEL FIBER CONCRETE

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2016

Concrete is brittle material and low tensile strength. Artificial fibers to improve the properties of conventional concrete is used in concrete production. One of the type of artificial fibers steel fiber, delay first cracks formation and cracks propagation. Steel fiber of reinforced concrete is higher ductility and toughness than conventional concrete.

In this study, deformation capacity of steel fiber reinforced concrete is examined. For this purpose, 15x30cm, 6x15cm and 10x10x50cm concrete samples were produced. 0.5x 40 mm notch was formed by the RILEM test method in the sample beam. In the mixture 420 kg/m³ PÇ 42.5 R cement and %10 silica fume was used. W/C=0.4 was obtained. 30 and 60 mm size of fibers 20 kg / m³, 40 kg / m³, 60 kg / m³ to be used in 3 different amounts. 30 mm fibers in size at each different fiber amount to the total fiber content of 100%, 85%, 70% was used. Different sizes produced on the 28-day samples was applied compressive strength experiments according to TS EN 12390-3, splitting tensile strength experiments according to TS EN 12390-6, rilem fracture energy experiments according to RILEM TC 50-FMC. Cylinder samples were applied ultrasonic pulse velocity experiments according to TS EN 12350.

According to experimental results, increased number of steel fiber in concrete was observed that decreased workability significantly. Increasing use of fiber ratio of steel fibers were observed increasing deformation capacity and toughness in concrete. Significant increase in the flexural strength was observed by the use of steel fibers.

Key Words: Hybrid Steel Fiber, Deformation Capacity, Compressive Strength, Splitting Tensile Strength

ÖZET

Lisans Bitirme Tezi

UÇUCU KÜL ESASLI GEOPOLİMER HARCIN MEKANİK ÖZELLİKLERİNE YÜKSEK FIRIN CÜRUFUNUN ETKİSİ

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Doğal minerallerin kimyasal kompozisyonlarının ve kristal yapılarının çeşitli yöntemlerle değiştirilmesi sonucu üretilen malzemelere ‘geopolimer’ adı verilir. Geopolimer harç ise yüksek dayanımı, sıcak ve soğuğa karşı direnci, çok düşük sünme ve büzülme, kimyasal direnç gibi birçok avantaja sahiptir. Geopolimer göstermiş olduğu bu özellikler ile prefabrik yapı endüstrisi, taşıyıcı ve taşıyıcı olmayan yapı malzemeleri, beton esaslı yol kaplamaları, zemin iyileştirmede kullanılabilir. Uçucu kül ise ekonomik olmasının yanı sıra betonun kolay yerleşmesini sağlayarak geopolimer ile kullanıldığında çok önemli katkılar verebilmektedir.

Bu çalışmada uçucu kül esaslı geopolimer harcın mekanik özelliklerine öğütülmüş yüksek fırın cürufunun etkisi araştırılmıştır. Karışımlarda uçucu kül 750 kg/m^3 olarak kullanılmıştır. Alkali çözelti/uçucu kül oranı 0.40 ve 0.55 alınmıştır. Alkali çözelti/Uçucu kül oranı 0.40 için kırmataş/geopolimer harç oranı 0.25, 0.75, 1.25 olarak alınmıştır. Alkali çözelti/uçucu kül oranı 0.55 için ise kırmataş/geopolimer harç oranı 1.5, 2, 2.5 olarak alınmıştır. Alkali çözelti için kullanılan Sodyum Hidroksit/Sodyum silikat oranı ise 1/2.5 alınarak hazırlanmıştır. Yüksek fırın cürufu ise uçucu külün %0, %10, %20’si olmak üzere 3 farklı oranda karışıma katılmıştır. Karışımlarda geopolimer harcın %5-%10’u arasında su ile birlikte uçucu külün %0.4-%0.7’si arasında süper akışkanlaştırıcı kullanılmıştır. Üretilen $4 \times 4 \times 16$ cm boyutunda üretilen numuneler TS-EN 196-1’e göre basınç deneyi ve TS-EN 196-1’e göre yarmada çekme deneyi yapılmıştır. Üretilen taze geopolimer harç 48 saat 60°C etüv edildikten sonra kür havuzunda bekletilmiştir.

Deneysel sonuçlarda geopolimer harçta kullanılan yüksek fırın cürufu oranı arttıkça özgül ağırlık değerlerinde ve basınç dayanım değerlerinde azalma meydana geldiği gözlemlenmiştir.

Anahtar Kelimeler: Uçucu Kül, Yüksek Fırın Cürufu, Sodyum Hidroksit, Sodyum Silikat, Geopolimer

ABSTRACT

Bachelor Science Thesis

THE EFFECT OF BLAST FURNACE SLAG ON THE MECHANICAL PROPERTIES OF FLY ASH BASED ON GEOPOLYMER MORTAR

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Geopolymer is the material produced result of changing the natural minerals chemical compositions and its crystal structures. Geopolymer mortar has many advantages such as high strength, resistance to heat and cold, very low creep and shrinkage, chemical resistance. Geopolymer is can be used in the prefabricated building industry, structural and non-structural building materials, concrete-based road paving, ground remediation, Fly ash is economic and besides it is providing an easy placing of concrete gives a very important contribution when used with geopolymer.

In this study, effect of blast furnace slag on the geopolymer mortar based on fly ash use of physical and mechanical properties was investigated. On the compositions fly ash is used as 750 kg/m³. Alkali solution/fly ash rate is taken 0.40 and 0.55 respectively. If alkali solution/fly ash rate is 0.40 then crushed stone/geopolymer binder rate is 0.25, 0.75, 1.25 respectively. If alkali solution/fly ash rate is taken 0.55 then crushed stone/geopolymer binder rate is 1.5, 2.0, 2.5 respectively. Sodium hydroxide/sodium silicate rate to be used for alkali solution is prepared with 1/2.5 ratio. Blast furnace slag mixed to mixture 0%, 10%, 20%. Also water ratio was taken around 5%-10% of the geopolymer binder and around 0.4%-0.7% of fly ash chemical superplasticizer has been used. Produced 4×4×16 sized specimens tested for compressive test according to TS-EN 196-1 and tested for flextural test according to TS-EN 196-1. After, produced fresh mortars put in 60°C kiln for 48 hours, they also waited in to a curing pool for 28 days for their strength measurement.

As a result of experiments, in the rate of blast furnace slag used in mortar increases specific gravity and compressive strength values were observed to occur.

Key Words: Fly Ash, Geopolymer Mortar, Flexural Test, Compressive Test.

ÖZET

Lisans Bitirme Tezi

YÜKSEK FIRIN CÜRUFU KATKILI ÇİMENTO HARCININ MEKANİK ÖZELLİKLERİNE ÇELİK LİFİN TEKLİ VE KARMA ETKİSİ

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Çimento harcı, yapı uygulamalarında oldukça geniş uygulama alanı olan bir yapı malzemesidir. Bununla birlikte, gevrek ve çekme dayanımının düşük bir malzeme olması çimento harcının zayıf özelliklerindedir. Çimento harcının bu zayıf özelliğini iyileştirmek için çimento harcı karışımlarında genellikle yapay lif türleri kullanılmaktadır. Çelik liflerde bu malzemelerden birisidir. Lifler, çatlak oluşumu ve yayılmasını geciktirerek çimento harcının çekme dayanımı ve sünekliğinin artmasına neden olmaktadır.

Bu çalışmada, yüksek fırın cürufu katkı çimento harcının mekanik özelliklerine çelik lifin tekli ve karma kullanımının etkisi araştırılmıştır. Numuneler, %2, %4 ve %6 toplam lif oranlarında 15mm ve 6mm uzunluğundaki çelik liflerin %100-%0, %75-%25 ve %50-%50 oranlarında karıştırılması ile hazırlanmıştır. Harç numuneleri TS EN 196-1'e göre üretilmiştir. Su/çimento oranı 0.50 olarak sabit tutulmuştur. Öğütülmüş yüksek fırın cürufu çimento miktarının %0 ve %10'u oranında karışımlarda kullanılmıştır. Üretilen taze harç üzerinde TS EN 1015-3'e göre yayılma deneyi gerçekleştirilmiştir. Çelik lifin yüksek fırın cürufu katkı sertleşmiş çimento harcının mekanik özelliklerine etkisini belirlemek için 4x4x16cm prizma ve 7x7x7cm küp numunelerinde TS EN 12390-7'e göre birim ağırlık-özellik ağırlık, 4x4x16cm prizma numunelerde TS EN 196-1'e göre basınç-eğilme, 7x7x7cm küp numunelerde TS EN 12390-6'a göre yarmada çekme deneyleri yapılmıştır.

Deney sonuçlarına göre belirli oranlarda tek ve karma katılan farklı uzunluktaki çelik liflerin çimento harcının yarmada çekme ve eğilme dayanımlarını iyileştirdiği görülmüştür. Çelik lif oranının artması ile işlenebilirliğin azaldığı gözlenmiştir.

Anahtar Kelimeler: Çimento Harcı, Çelik Lif, Basınç Dayanımı, Yarmada Çekme Dayanımı

ABSTRACT

Bachelor Science Thesis

THE EFFECT OF SINGLE AND HYBRİD STEEL FIBER ON MECHANICAL PROPERTIES OF BLAST FURNACE SLAG BLENDED CEMENT MORTAR

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Cement mortar is a construction material which has very wide application range in the structural application. However its brittleness and tensile strength are weak properties of cement mortar. In some applications, fibers may be used on cement mortar mix to improve weak properties of traditional concrete. Steel fibers are examples of those materials. High tensile strength and ductile cement mortar can be produced by avoiding crack formation and spreading with fibers addition.

In this study, the effect of single and mixed use of steel fiber on mechanical properties of blast furnace slag blended cement mortar has been researched. Cement mortars have been prepared by mixing steel fiber with 2%, 4% and 6% total ratios and, steel fibers which have 15mm and 6mm with 100%-0%, 75%-25% and 50%-50% mix ratios. Mortar specimens have been produced according to TS EN 196-1. Water/cement ratio has been kept constant as 0.50. Ground blast furnace slag has been used on mixes as 0% and 10% ratios of amount of cement. In produced fresh mortar, flow test has been applied according to TS EN 1015-3. To determine the effect of steel fiber on mechanical properties of blast furnace slag blended hardened cement mortar, unit weight-specific weight test with 4x4x16cm prism sample and 7x7x7cm cube sample according to TS EN 12390-7, compressive-flexural test with 4x4x16cm prism sample according to TS EN 196-1, and according to TS EN 12390-6 splitting tensile test with 7x7x7cm cube sample have been applied.

According to experimental results, it has been observed that by certain amount of addition of single and mixed steel fiber have increased the splitting tensile strength and flexural strength of cement mortar. It has been observed by increasing of steel fiber ratio, workability has decreased.

Keywords: Cement Mortar, Steel Fiber, Compressive Strength, Splitting Tensile Strength



**GRANİT ÇAMURUNUN TAŞ MASTİK ASFALT KAPLAMALARDA FİLLER
OLARAK KULLANILABİLİRLİĞİNİN ARAŞTIRILMASI**

**Neşet Berkay KÖKLÜ, BilalA YDEMİR, Barış BİNGÜLLER, Batuhan ÇAKIR,
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Küreselleşme, nüfus artışı, endüstri ve teknolojinin gelişmesi insan ihtiyaçlarının farklılaşmasına ve artmasına neden olmuştur. Artan ihtiyaçların karşılanması ancak üretilen malların ihtiyaç sahiplerine ulaştırılmasıyla sağlanabilir. Bu etki, karayollarının proje ömürleri süresince maruz kalacakları trafik hacmi ve yüklerine daha kısa sürede maruz kalmalarına neden olmaktadır. Taş Mastik Asphalt (TMA) kaplamalar 1960'lı yıllarda Almanyada geliştirilmiş ve özellikle tekerlek izi ve çivili lastiklerden kaynaklanan aşınmalara karşı gösterdiği direnç bakımından Avrupa'da kullanımı yaygın hale gelmiştir. Bu çalışmada İzmir ÇİMSTONE Fabrikasından getirilen granit atık çamurunun taş mastik asphalt kaplamalarda filler malzemesi olarak kullanılabilirliği araştırılmıştır. Çalışma kapsamında iri agregalar (No:4 üstü) olarak Afyon Belediyesi Asphalt üretim tesislerinden temin edilen bazalt kökenli agregalar, ince agregalar (No:4-No:200) olarak kireçtaşı kökenli agregalar ve filler (No:200 Altı) malzemesi olarak kireçtaşı ve granit kökenli agregalar kullanılmıştır. Kullanılan agregalar numunesi için beş farklı oranda atık granit fillerleri (%7, %8, %9, %11, %12) ve kontrol amaçlı olarak %10 oranında kireçtaşı fillerleri kullanılmış ve her

bir filler miktarı için Superpave dizayn yöntemiyle dizayn yapılarak optimum bitüm miktarları belirlenmiştir. Çalışma sonuçları granit çamurunun filler malzemesi olarak taş mastik asfalt karışımlarında kullanılabileceğini göstermiştir.



E-BUSINESS APPLICATIONS IN TURKISH CONSTRUCTION FIRMS

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This study is designed to measure the construction industry's attitude toward Internet technologies and e-Business applications. Is the construction industry beginning to embrace the technology of tomorrow and use it to their advantage, or are they stuck in their old ways? Will these companies continue to evolve in their thinking?

One objective of this study is to determine if the general attitude of the construction industry in Turkey toward e-Business is beginning to change in acceptance of technology, and how its acceptance of this technology can be used to the advantage of the industry. Furthermore, if the industry has accepted this new idea, how have they implemented e-Business applications into their current business operations.

Implementation of e-Business applications according to the occupations, positions, experience levels of companies and the number of employees in the company. In the first stage of this study, e-Business has been comparatively observed among employees and in superior-subordinate relationship in construction industry. It is emphasized with a survey, which is to determine if the participants were ready to have e-Business applications in their companies, with extremely clear questions. In the second stage of this comparative study, a questionnaire was surveyed to understand the differences, 30 participants were interviewed for this study with proper questions; to understand the operational preparation, vision share, change model, communication, leadership capacity and partnership liabilities, organizational design and performance management, information and team capacity, culture and change process among the construction companies. Results are obtained and analyzed by using the SPSS (Statistical Package for the Social Sciences) software. It has been displayed that there are some differences between the higher number of employees and the lower number of employees in the construction companies.



Effects of Staircases on the Seismic Performance of Reinforced Concrete Buildings

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There are many factors resulting with failure in the frame members or collapse of the whole building during the earthquakes. The staircases are a significant factor affecting the seismic performance of reinforced concrete buildings. Staircases are very critical in the evacuation of people after earthquakes. The main effects of the staircases are briefly; short column effect, torsional effect, staircases increases the seismic demand of the frame structures combined to stairs. In general, the landing of the stair carried by a beam located at the middle level of the storey and this causes to short column effect on the columns connected to that beam. Stairs increases the rigidity of the structures, and if the stair is not located symmetrically, it changes the location of the rigidity center of the structure and this will cause a torsional effects during earthquakes. Also, as mentioned above, stairs have a considerable rigidity and this increases the seismic demand of the stair during the earthquakes. That seismic demand affects the stair and the frame members connected to stair in a bad manner, and this effect may cause failures in the frame members, if their capacity is inadequate to support the seismic loads.

The energy dissipation of the structural members resulting with the non-elastic deformations under lateral loads is called as plastic hinges. The plastic

hinge formation in the reinforced concrete structures is crucial. In this study, the project has been conducted to observe and determine the structural members in which the plastic hinges seen initially, and to determine the degree of the effects of the staircases on the seismic performance of the reinforced concrete buildings. A four storey building has been analyzed by using SAP2000 software program. Analysis has been completed with structural models with no-stair , and stairs at different locations. After the analysis, the effect of the staircases have been seen as it is mentioned above. To prevent the building failure caused by staircases, shear walls have been located symmetrically on the structural plan of the building.

The study shows that the staircases should be considered during the design process, and symmetrically located shear walls decreases effects of the staircases on the reinforced concrete buildings.



SEISMIC BEHAVIOUR OF DIFFERENT BRACING SYSTEMS IN HIGH RISE 2-D
STEEL BUILDINGS

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In seismically active zones, structures are subjected to lateral earthquake forces in addition to bearing the primary gravity load. The performance of a structure during an earthquake depends on the intensity of the earthquake and the properties of the structure. In seismic events, the response of a steel structure is found to vary from elastic to highly inelastic. Steel structures should be designed to dissipate large amounts of energy during a severe seismic excitation, thus ensuring the sufficient lateral stiffness and strength.

This study aimed to compare the seismic behavior of different bracing systems in high rise 3-D steel buildings. Nonlinear static pushover analyses were carried out to assess the structural performance on different bracing systems in high rise steel buildings of 3, 9 and 20 storeys. Three structural configurations were used: moment resisting frames (MRFs), X-braced frames (XBFs) and knee-braced frames (KnBFs). The effects of some parameters influencing the seismic performance, including type of the bracing system, the height of the building and lateral load patterns, were investigated. The results show that the different braced frames performed well in terms of storey displacement, inter-storey drift ratio, base shear and performance point when compared with the moment resisting frame in high rise steel buildings. It can be concluded, on a comparative account of the obtained results, that use of KnBF enhance structural performances.



**HYDROLOGIC MODELING OF GÜVENÇ BASIN
USING HEC-HMS MODEL**

Ömür ÜSTÜNER

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The need for water increases day by day in a society. While water should be used efficiently for domestic, agricultural and energy requirements, precautions should be taken for excess water that may cause flood inundation. In this respect, the objectives should be to conduct proper hydrologic and hydraulic designs at certain locations using measured data for the planned water structures.

In this study, geomorphologic basin characteristics are determined using GIS for a pilot drainage basin representing Central Anatolia. Afterwards, rainfall-runoff relationship is simulated in the basin by applying HEC-HMS model on event basis. Several different storm events are replicated in order to find model parameters for the basin and modeling performance is measured with various goodness-of-fit criteria.

Keywords: Hydrologic Modeling, GIS, HEC-HMS, Güvenç Basin



PILE FOUNDATION DESING

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Pile foundation is a type of a deep foundation, which works under vertical structural loading cases. Piles can be constructed with driven and bored types into the strong layer at the site. In this project, soil samples were taken from building site and laboratory experiments were done according to the required standarts. According to these experiments, the characteristics of soil were identified and soil investigation report was prepared. After calculation of bearing capacity, settlement and liquefaction potential, the use of pile foundation under mat foundation was decided. Afterwards, pile foundation calculations such as bearing capacity, cost analysis, group efficiency were determined. In addition to this calculations, computer softwares (STA4CAD, PLAXIS 2D, IDECAD) were used to compare the results of calculations. The reinforcement requirements were calculated with respect to most critical axial stress, shear stress and bending moment values which are taken from PLAXIS 2D.

As a result, the design was evaluated and to decide for upper structure to support safely by piled foundation.



KAZIKLI RADYE TEMEL TASARIMI

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Kazıklı radye temeller, zemin koşullarının elverişli olmadığı ve yüzeysel temellerin de izin verilebilir sınırları aştığı durumlarda, yapı yüklerinin sağlam zemine aktarılmasında, hem radyenin hem de kazıkların kullanıldığı bir temel sistemidir. Kazıklı radye temellerin, oturma değerlerinin düşürülmesi, yüzeysel temelin taşıma gücünün artırılması ve sıvılaşma riskinin üst yapıya iletilmemesi amacı ile 3 temel kullanım sebebi vardır. Bu doğrultuda yapılan laboratuvar çalışmalarında zeminden elde edilen parametreler ile hesaplanan zemin taşıma gücünün ($q_{av}=3,37 \text{ t/m}^2$), yapıdan zemine iletilen gerilme ($q_{str} = 17,38 \text{ t/m}^2$) değerinden fazla olması, oturma miktarının ($s=65,7 \text{ cm}$) yüzeysel temeller için izin verilebilir sınırdan fazla olması ve sıvılaşma potansiyeli bulunması sebebi ile kazıklı radye temel tasarımına gidilmiştir. $273,3 \text{ m}^2$ temel alanına sahip 13 katlı konut projesi için tasarlanan kazıklı radye temel kalınlığı 1,2 m olmakla birlikte 80 cm çapında 16 m uzunluğunda 45 adet kazık kullanılmıştır. Analiz için zeminde bilgisayar destekli tasarım programı Plaxis2D, üst yapıda Sta4Cad, kazık düzeni, zemin profili, zımbalama etkisi ve benzeri durumlar için ise Autocad kullanılmıştır.

Yapılan tasarım ve analizler sonucunda projesi önerilen üst yapı, kazıklı radye temel sistemi ile emniyetli şekilde taşınır hale gelmiştir. Bu sonuca göre oturma ve sıvılaşma potansiyeli etkileri de minimize edilmiştir.



**SEISMIC PERFORMANCE OF A MASONRY RESIDENTIAL BUILDING
WITH OPENINGS**

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A considerable amount of masonry construction is determined to be risky according to 6306 Code. According to this code, at the level of critical storey(ground floor), the shear strenght of the bearing walls and the shear forces which result from the seismic effect is compared. In any principal direction of the building, if the ratio of the total shear forced resisted by the bearing walls, which do not have adequate shear strenght, to the total story shear force is more than 50%, the masonry buildings is considered to be risky according to this code.

A three storey exiting masonry building is investigated in detail. The structure is first modelled in StatiCAD, which a commercial software in analyzing masonry buildings to identify whether the building risky or not in terms of seismic actions. The StatiCAD analyses were confirmed with hand calculations. On the other hand, the Finite Element Model (FEM) of the building is generated in Sap2000 by modelling the bearing walls eith shell elements. Shear forces in the walls obtained from all calculations are compared. FEM results considerably less shear demands on the walls.

According to Turkish Earthquake Code (2007), rigidity of a wall in a masonry building is calculated by article 5.3.3.1 when the hand calculation was prepared.

Result of the distiribution was that the corresponding walls was taken on approximately 60% of the total shear forces at the critical level according to StatiCAD and the building must be risky. On the other hand, according to the Finite Element Model the corresponding wall was subjected only %32 of the total shear forces at the level of ground floor. So, it is not risky.



**PROBLEMS IN APPLICATION OF LAW NO.6331 IN CONSTRUCTION
INDUSTRY: AN INVESTIGATION AMONG HEALTH & SAFETY EXPERTS**

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The Law on Occupational Health and Safety No. 6331, governing the health and safety standards to be adopted by employers in Turkey, has been published in the Official Gazette No. 28339 dated 30 June 2012.

The aim of Law No. 6331 is to regulate the duties, powers, responsibilities, rights and obligations of employers and employees in order to ensure occupational health and safety in workplaces and to improve existing health and safety conditions. This Law covers all types of employment, work and workplaces that belong to the public and private sectors, owners and/or employers of subject workplaces and representatives/agents of such employers, and all employees including apprentices, interns and trainees, regardless of the fields of activity in which they are involved, other than a few explicitly stated exceptions.

The aim of this research is to investigate problems in application of Law No. 6331 in construction industry by health & safety experts.



**THE EFFECT OF ISOLATION PERIOD ON AMPLIFICATION OF MID IN CASE
OF ECCENTRIC SUPERSTRUCTURE**

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Seismic isolators are seismic protection systems to decouple the superstructure from the catastrophic effects of strong ground motions. This is achieved by providing necessary amount of flexibility and damping at the isolation level. In this study, the effect of isolation period on the response of three-storey isolated structures with eccentric superstructures was investigated. The mass eccentricity in both of the horizontal directions of the superstructure and the Q/W ratio are kept constant ($Ecc= 5\%$, $Q/W= 0.1$) and four different isolation period (2.25 ,2.5 ,2.75 ,3 sec) are analyzed by using OpenSees program. While analyzing bi-directional ground motion excitations are subjected to model. Variation of amplification in MID in an eccentric superstructure for different isolation periods is studied. The results show that the effect of isolation period on the amplification of MIDs in case of eccentric superstructures is insignificant.



PILE FOUNDATION DESIGN

Burak TUĞCU

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Pile foundation are very suitable, if the soil layers under the foundation is weak. Pile foundation design is based on upper structure data, soil parameters and theoretical approaches.

In this study, lots of different topics about the pile foundations were mentioned. Soil investigation report and evaluation were prepared. After that, bearing capacity of single pile in different diameter (such as 65 cm, 80 cm and 100 cm), settlements for each layer, load bearing capacity of group piles and efficiency of group pile were determined. Also jet grouting project was prepared for unsuitable soil layer. All calculations made by hand and then the PLAXIS 8.1 program was used to control the calculations based on finite elements model.

As a results, unsuitable conditions of the soil layers are removed by using pile foundation. Undesirable settlement is prevented and bearing capacity is increased to support safely to the upper structure.

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Sabit Akarsu Bağlama Projesi Özeti

Bu final projesinde, bir akarsu üzerine yapılması istenen sabit bir bağlama (çevirme yapısı) projelendirilmiştir. Bağlamalar, su seviyesini yükseltmek ve suyu yönlendirmek için inşa edilen su yapılarıdır.

Bu projede sırasıyla şu hesaplar yapılmıştır :

- Bağlama yapılacak akarsuyun en kesiti verilen koordinatlarla çizilmiştir.
- Akarsuyun değişen su seviyesine göre üzerinden geçecek debiler hesaplanmış ve akarsu anahtar eğrisi çizilmiştir.
- İhtiyaç debisine göre su alma yapısı (isale kanalı-çökeltim havuzu-rakortman) boyutlandırılmıştır.
- Su alma yapısı boyunca meydana gelen yersel ve sürekli yük kayıpları hesaplanmıştır.
- Bilinen isale kanalı su yüzü kotuna yük kayıpları eklenerek bağlama kabartma kotu hesaplanmıştır.
- Bağlama kabartma kotu belirlendikten sonra bağlama kret kotu ve kret uzunluğu bulunmuştur.
- Minimum debi kullanılarak bağlamanın yüksekliği hesaplanmıştır.
- Maximum ve minimum debilere göre düşüm yatağı boyutlandırılmış ve uygun olan boyutlar seçilmiştir.
- Bağlama statik hesapları yapılmıştır.
- Alta sızma hesapları yapılmış ve sızmaya karşı önlemler alınmıştır.
- Bütün hesaplar tahkik edilmiştir.