not accepted by the general public and must be disposed properly. C & D wastes often due to the lack of proper management, are stacked or buried in the periphery of cities, roads and rivers are disposal, while most have the ability to be recycled and reused. On the other hand, due to different material properties in various regions, discover the proper loan resources for civil projects always including the challenges is facing the design engineers.

This study investigates the reuse of C & D wastes such as concrete and cement blocks resulting from the construction and demolition processes of Pars 2 region, in pavement layers. Due to the scarcity and high value of land in the region, disposal options of this typical debris are not cost effective and should be recycled as part of the waste of construction process operations. On the other hand due to the lack of quarried rock mines in this region, excessive use of river materials, causes the loss of the normal cover from earth surface and ultimately results in soil erosion. Hence, the reuse of C & D wastes in the construction process would be economically and environmentally affordable.

This debris after being crushed in a crushing machine, results grains with diameter ranging from 0 to 25 mm size four mixes with the percentage of recycled aggregates zero , 10 , 30 and 50 percent were prepared to evaluate the performance of the combined pavement layers.

Results indicated that these aggregates have less specific weight and durability and show higher water absorption in comparison with the natural aggregates.

Key Words: Recycled aggregates, cement block, road pavement, specific weight, water absorption.

NUMERICAL STATISTICAL ANALYSIS OF UMBRELLA DRAIN PERFORMANCE IN DEEP CIRCULAR LINED TUNNELS UNDER STEADY-STATE SEEPAGE

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Abstract

One of the major issues in design and construction of tunnels is seepage and it's been highlighted by an extra force which is generated by pore water pressure and directed towards the tunnel walls. Since this extra seepage force may lead to instability in soils and weak rocks with low permeability, the necessity of drainage in such tunnels is visibly clear. Drainage systems in tunnels have different types and materials and the most common ones are peripheral filter drainage and pin-hole drainage systems. Despite the drainage system importance, very limited studies have been conducted on the drainage systems and the effective factors affecting their performance. The need for such systems is clearly felt during construction of many tunnels during the writers field studies.

In this article, Umbrella drainage system is presented as a new alternative drainage system for the tunnels under steady state seepage condition. The arrangement of this system is an smart combination of Pin-Hole drainage system and it is inspired by forepoling method of support installation. In this study, the performance of the aforementioned drainage system is investigated through numerical statical three dimensional analysis of the lining for deep circular tunnels subjected to steady-state seepage by using ABAQUS finite element software. Furthermore an optimum arrangement for pipes in the drainage system is presented by taking into account the maximum effective principle strain for the lining of a tunnel as a monitored parameter. Also the effective factors affecting the drainage tube of the draining system is to investigated. Moreover, all of the factors with an influence on the drainage tube of this draining system is explored through investigating the pore water pressure distribution on the surface of the lining of a tunnel and considering it as a type of effective loading in designing the lining of the tunnel and also estimating the drained volumetric discharge of the drainage tubes.

Key Words: Umbrella drainage, deep circular lined tunnel, steady-state seepage, numerical statistical analysis.

value of the quality criterion under optimum condition is predicted. In order to validate the accomplished study and evaluate the Taguchi method, a proof test, based on the optimum combination, is usually built, and its result is compared with the software prediction. In this research, due to the numerous factors affecting the compressive strength and unit weight of concrete, four governing factors are selected: pumice with sieve type 1, pumice with sieve type 2, sand and filler. In addition, pumice with sieve type 3 has been also selected as a complementary factor. The remaining materials, such as the ratio of water to cement, additives and cement weights, are considered as constant. In order to determine the optimum combination, the orthogonal array of L9 is utilized and after the analysis and determination of optimum levels, the results of laboratory proof tests and prediction of the Taguchi method were compared. The results demonstrate that the systematic Taguchi design method is very useful in reaching the optimum mix design of semi-structural lightweight concretes.

Key Words: Taguchi, lightweight concrete, pumice, lightweight aggregate, design of experiments, optimization, minitabm.

CARBONATION AND CORROSION POTENTIAL OF STEEL REINFORCEMENT IN POROUS CONCRETE

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Abstract

As porous concrete has acoustic and drainage characteristics, it is used in many concrete structures, such as pavements, reinforced panels, and so on. In this research, the mechanical characteristics, carbonation and corrosion potential of embedded steel reinforcement, such as compressive strength, percent of carbonation, capillary absorption coefficient and corrosion potential, are investigated. The hydrophobic agent is poured into some mixtures to evaluate the effect of this admixture on the hardened specification of concrete.

It is known from results that all porous mixtures are very sensitive to the carbonation process because of their porous structure and the entry of carbon dioxide at the full depth of these concretes. Although the hydrophobic agent has no effect on the structure of concrete, for decreasing the saturation percent of capillary pores, these agents can decrease the rate of concrete carbonation. For porous structures of this kind of concrete, and the small thickness of paste layer around the steel reinforcement in comparison with conventional concrete, the rate of the carbonation process in porous concrete is faster than in conventional concrete. The results show that application of a hydrophobic agent causes a decrease in capillary absorption coefficient, so, the probability of the presence of water for initiation and expansion of the corrosion process is decreased. It is found that the capillary absorption coefficient has a linear relation with corrosion potential, wherein increasing the capillary absorption coefficient cause an increase in corrosion potential in the reinforcement of porous concrete, respectively.
Therefore, usage of a hydrophobic agent in porous concrete mixtures not only causes a decrease in the rate of carbonation, but may also propagate the time of initial corrosion.

Key Words: Porous concrete, corrosion, carbonation, hydrophobic agent.

SPECIFIC GRAVITY AND WATER ABSORPTION OF RECYCLED CONCRETE AGGREGATES (CASE STUDY; PARS -2 KANGAN REGION)

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Abstract

Despite the fact that construction and demolition wastes (C and D wastes) compared to other types of waste has less risk to the environment and their management is relatively simple, but from an aesthetic point of view was

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Abstract

Oil storage tanks are used extensively in different national industries such as refineries, power plants and fuel storage facilities. Therefore, the seismic safety and stability of this kind of tank during strong earthquakes are very important. Many existing tanks are designed, constructed and operated based on outdated versions of standards and code requirements. Therefore, investigation into existing tanks using the latest versions of international standards and their retrofitting is necessary. In this study, reducing fluid wave sloshing height in steel storage tanks using an annular baffle as a damping device installed on the tank shell is investigated. Based on the widespread use of baffles in moving liquid containers, especially in space vehicles, the ability of baffles to reduce sloshing effects in storage tanks that are especially broader than fuel containers is under question.

The primary objective of the shake table study made in this research is to provide test data for verification of numerical models and to recommend a practical baffle arrangement that would be effective over a range of frequencies. For this purpose, a typical tank model with a geometrical scaling of 1/16 is considered in this research as representative of anchored tanks with different height to diameter ratios. At the Laboratory of the International Institute of Earthquake Engineering and Seismology (IIEES) in Tehran, a shaking table test was undertaken to evaluate sloshing wave amplitudes in scaled model steel storage tanks in cases of with and without annular baffles. Three earthquake ground motion records are used as input base motions to the studied tank model generated by the shaking table. Four different liquid filling levels and 3 types of baffle arrangement are used to investigate the effect of the number and location of baffles on sloshing amplitude reduction during the earthquake in the studied tank model. The results of studied models indicate that the annular baffles have significant effects in reducing sloshing wave height as sloshing dependent dampers, and can be used in oil storage tanks.

Key Words: Aboveground steel storage tanks, baffles, sloshing dependent dampers, shaking table.

APPLICATION OF TAGUCHI METHOD ON OPTIMIZATION OF SEMI STRUCTURAL LIGHTWEIGHT CONCRETE COMPOSED OF PUMICE AGGREGATES

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Abstract

From a strength point of view, lightweight concretes are categorized into three groups of structural, semi-structural and non-structural concretes. The main purpose of this research is to determine the optimum mix design of a semi-structural lightweight concrete composed of pumice aggregates with the lowest unit weight and a reasonable compressive strength. For this purpose, the Taguchi method, with four effective factors and three levels, has been adopted. The method is a systematic design of experiments which can efficiently reduce the time and cost of experiments. In this method, the most effective factors are selected and different levels are determined for each factor. Then, based on the number of factors and the assigned levels, a suitable orthogonal array is chosen using the Taguchi guideline. These arrays can provide a regular program for the experiments, including the number of tests and the combination of different levels in each test. At the end of each test, the corresponding quality criterion is obtained. Using the results of systematic tests via MINITAB software, the optimum combination is determined and, thus, the

made between the formulas used for estimation of scour depth, and then the resulted data from analyzing different models with different ratios of pier spacing to pier width were investigated using BRI-STARS. Comparing Froehlich and CSU relations reveal that the Froehlich equation estimates the scour depth 11 percent more than the CSU formula. Also, the Froehlich is more conservative due to the design criteria. The increasing of scour depth in models with x/b<7 is negligible when the CSU formula was applied, and in models with x/b < 8.5 when the Froehlich formula was used. In order to select the optimum location of a bridge with regard to the scour condition, hydraulic parameters, such as free surface elevation, Froude number, depth the averaged velocity and bed erosion under the effect of pier location, were examined. Finally, by processing the resulted data, the best diagram and equation for estimating increases in scour depth, according to different pier spacing to width ratios, were presented. Also, it was shown that when y/b<3.2, the flow relative depth has an effect on scouring, but, when the y/b became less than 2.75, the scouring was not influenced by flow relative depth.

Key Words: Numerical simulation, scouring, bridge piers, stream tubes, bri-stars software.

INVESTIGATION OF THE EXACT SEQUENTIAL CONSTRUCTION ANALYSIS IN COMPARISON WITH THE CONVENTIONAL ANALYSIS AND THE APPROXIMATE CFM METHOD

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Abstract

Nowadays, in common structure analyses, dead and live loads of all floors are applied instantaneously. In fact, it is assumed that the structure does not bear any load before the end of construction. This assumption could be valid for lateral loads or the dead loads of subsequently installed components, but it is unsuitable for the dead loads of the structural members and floor because these types of loads are gradually applied to the previously constructed members during the progress of construction, which depends on technology and construction planning. According to the sequence of construction, structural members are added to stages as the building construction proceeds; therefore, their dead load is carried by the part of the structure completed during their installation stage. Hence, it is clear that the distribution of displacements and stresses in the constructed part of the structure at any stage does not depend on the sizes, properties, or the presence of members composing the remainder of the structure. In this procedure the deformations of the lower stories are already taken place under the self weight of their floors even before the upper floors are built. Hereupon, in each stage of construction, the newly- built members are installed on the previously deformed members of the structure, and the final deformation of structure is the cumulative outcome of deformations in construction of each story until the completion of the final stage of construction. Ignoring the effect of sequence of construction may lead to seriously incorrect analysis results, particularly at the upper floors of the building. In this paper, the exact method of sequential construction analysis has been investigated, and also the manual method of calculating the elastic sequential analysis has been studied in order to have the sufficient knowledge of how the software works. To comprehend the necessity of sequential construction analysis, the outcomes are eventually compared with the conventional analysis and simulation methods of the real behavior of the structure, compatible with the real construction schedule such as CFM method. A 21-story steel structure has been chosen as a case study to achieve the aforementioned purpose of this paper.

Key Words: Staged sequential construction analysis, conventional analysis, correction factor method - CFM, column shortening.

SHAKING TABLE STUDY ON THE EFFECT OF BAFFLE IN SLOSHING REDUCTION IN ABOVEGROUND STEEL STORAGE TANKS

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the pile is more effective than the total length of the pile. Based on the numerical results, effective parameters are discussed and a formula for the lateral bearing capacity of a fixed-head pile in sand is recommended.

Key Words: Fixed-head single piles, lateral bearing capacity, soil/ pile interaction, finite element analysis, Open Sees Pl.

RISK ASSESSMENT MODEL BASED ON FUZZY EXPERT SYSTEMS FOR CONSTRUCTION PROJECT MANAGEMENT

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Abstract
Construction projects, due to their size and complexity and their unique and dynamic nature, makes them impossible to model accurately. These attributes reveal the enormous need in these projects for a proper method of risk assessment. Furthermore, the main uncertainties involved in these projects are resulted because of vagueness (e.g. in cost estimation, time estimation, etc.), so, traditional methods used in the context of risk assessment, which are mainly based on probability theory, are not satisfactory for these projects. The aim of this paper is to propose a methodology based on hierarchical fuzzy rule based expert systems to assess the total risk of construction projects and also rank the risks based on their magnitude. For this purpose, a suitable hierarchical risk breakdown structure (HRBS) for construction projects is used to develop a formal frame for qualitative risk assessment. The highest layer of HRBS is the total risk of the project and the lowest layer consists of the factors influencing each risk. Then, for relating the different layers of the HRBS and developing the expert fuzzy system, a method is used to extract the fuzzy rules based on expert opinion. Finally, this fuzzy system is programmed. The efficiency of the proposed model has been analyzed for assessing risks of a construction project in Tehran. Risk assessment in this case study has been undertaken from the client, contractor and consultant points of view, separately, and also after aggregation of their opinions. The results show that the presented methodology can be used to assess risks related to cost, time, quality and safety in construction projects.

Key Words: Risk assessment, construction projects, hierarchical structure, risk breakdown, fuzzy expert systems, fuzzy rules.

NUMERICAL EVALUATION OF PIERS SPACING EFFECT ON HYDRAULIC AND SEDIMENTARY PARAMETERS OF RIVER FLOWS USING BRI-STARS (CASE STUDY)

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Abstract
The scour of bridge piers is one of the most important factors affecting the stability of bridges constructed over rivers. Many studies have been conducted to evaluate the depth and intensity of scouring around bridge piers. Due to the complexity of this phenomenon, most existing formula cannot estimate the scour depth with reasonable precision. In this paper, regarding the importance of scouring in bridge design, a comparison was

and also difficult to interpret, in spite of their high accuracy in seismic response estimation of the structures, they cannot be used in everyday engineering work. In contrast to dynamic procedures, pushover methods are simple, practical and easy to understand. Based on these facts, pushover methods have been the main subject of much research conducted during recent years. As an introduction to performance-based structural design, ATC-40 and FEMA-356 have introduced the capacity spectrum method (CSM) and the displacement coefficient method (DCM), respectively. Since, in these methods, the lateral force distribution is assumed to be constant and is calculated based on the fundamental vibration mode of the elastic structure, they can provide accurate seismic demand estimates only for low and medium-rise buildings, where the contribution of higher modes in seismic responses is negligible. In order to improve the capability of these conventional procedures, different methods have been presented by researchers. Following these efforts, in the present study, an innovative adaptive pushover analysis considering torsional effects (APAT) has been developed. APAT is a single stage procedure which uses an equivalent adaptive load pattern. In order to consider the effects of higher modes, especially rotational modes in 3D structures with noticeable torsional effects, and due to the known drawbacks in common combination methods, such as square root of the sum of the squares (SRSS), herein, an effective modal mass combination (EMMC) rule for multi-story buildings is used. In the EMMC method, load vectors are combined based on determined coefficients for each mode. These coefficients are defined using effective modal mass proportions. The equivalent load pattern in the present study is obtained through a combination of different modal shapes based on the EMMC rule. In order to capture the torsional effect, a three dimensional energy-based formulation is used which transforms the MDOF structure to an equivalent SDOF model. In the three dimensional energy based formulation, work undertaken by both translational and rotational forces is taken into account. The accuracy of the proposed procedure is evaluated for a series of asymmetric structures. The parametric study shows that the proposed method could predict seismic responses precisely, even in structures with significant torsional effects.

Key Words: Nonlinear static analysis, pushover, torsion, asymmetric plan building, seismic analysis.

NUMERICAL EVALUATION OF LATERAL BEARING CAPACITY FOR FIXED-HEAD PILES

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Abstract

Piles are used extensively to resist lateral load from earth pressure, inclined load, wind, waves, earthquakes, etc. The behavior of piles subjected to lateral loads is governed by interaction between the pile and the soil, and it is a non-linear, three-dimensional soil-structure interaction problem. Pile properties, including pile stiffness and geometry, and soil properties, i.e., unit weight, stiffness, friction angle, cohesion and the pile/soil interface, play important roles in the response of piles subjected to lateral loads.

Existing methods for the analysis of laterally loaded single piles can be generally classified into the following five categories: (1) the limit state method; (2) the subgrade reaction method; (3) the p-y method; (4) the elasticity method; and (5) the finite element method. However, the effect of fundamental soil properties (e.g., strength, stiffness, and volume change characteristics) on the response of pile and soil cannot be appropriately addressed in these methods. Thus, an investigation into the effects of fundamental pile and soil properties on the soil response of a pile subjected to lateral load is necessary and helpful in improving insight into the soil/structure interaction problem for a laterally loaded pile.

A fundamental study into the soil/ pile interaction response of fixed-head piles subjected to static lateral loads in sands is conducted using the non-linear finite element approach. The effects of pile properties, i.e., length and diameter, and soil properties, i.e., the horizontal coefficient of earth pressure, unit weight and stiffness, on the pile response of a pile subjected to lateral load, are also investigated.

In the numerical model, the pile was treated as a linear elastic material and the soil was idealized using the multi-yield-surface plasticity model with a non-associated flow rule. The improvement in pile lateral load was found to be strongly dependent on the pile diameter, soil friction angle, and relative density of the sand. It was also found that the effective embedment length of

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Abstract

Masonry arch bridges are among important and old bridges in the Iranian railway network. Retrofitting and renovation of these bridges are important, not only due to their vital role in the national railway network, but also as most of them are highly valued from an architectural as well as cultural and historical point of view. In this paper, an external reinforcing method for strengthening masonry arch bridges is presented and particularly examined for Ghaflankooh Bridge, located at kilometer 427 of the Tehran -Tabriz railway. A 3D finite element model of the bridge developed using SAP2000-v14 software. Using this model the proper retrofitting plan is determined. In addition the influence of the ratio of the elastic modulus of masonry materials to filled materials on the internal stresses over the bridge body is investigated. The results shows that by increasing this ratio, the stresses increased over the external surface of the arch and as a results a proper retrofitting scheme can be achieved using lesser materials and lower costs.

Key Words: Strengthening, external reinforcement, railway, masonry arch bridge, elastic modulus.

INTERACTION OF PILES GROUP WITH REVERSE FAULT RUPTURE

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Abstract

In many large magnitude earthquakes, the causative fault propagates all the way up through the soil and interacts with surface structures. Over the last four decades, earthquake engineering research and practice have emphasized the dynamic response of soil and structural systems to ground oscillations. Even so, recent strong earthquakes (i.e. the 1999 Chi-Chi Taiwan earthquake and the Landers 1992 California earthquake) have caused major collapse to structures from surface fault ruptures. Previous research has not concentrated on studying the response of soil-structure systems to large displacements induced by surface fault ruptures.
Although piles are usually used for protecting structures by reducing total and differential settlements, they are not an acceptable treatment in supporting structures from surface fault rupture. Previous research has shown that piles usually follow fault rupture deformation and transfer it to the structure. Therefore, this behavior is a reason for the unsuitable performance of a piles group against fault rupture. In order to study the interaction of the soil and the piles group during reverse fault rupture carefully, in the first step, the propagation of fault rupture in free field is modeled. For this purpose, a 2D numerical model is verified by reduced-scale experiment results. In the numerical models, a nonlinear finite element method, using an elastoplastic constitutive model with Mohr-Coulomb failure criterion and isotropic strain softening characteristics, is used. For the main analysis, the effects of the presence of a piles group on top of the outcropping fault are simulated. The analysis results indicate that the presence of the piles group slightly modifies the fault rupture path.

Key Words: Surface fault rupture, piled foundation, reverse fault, finite element method.

AN ADAPTIVE PUSHOVER ANALYSIS CONSIDERING TORSIONAL EFFECTS

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Abstract

Development of performance-based structural design during the last decade, has led to extensive research into nonlinear static (pushover) procedures. Since nonlinear dynamic methods are time consuming, impractical

was obtained which only depends on net radiation and temperature. The derived reference and water surface energy balance (RWEB) model were applied to estimate evaporation from the Doosti dam reservoir and was compared with other conventional methods. To evaluate the performance of the RWEB model, it was compared with the BREB and the pan methods. According to the evaluations, the RWEB results obtained for evaporation from 2011 to 2012 were satisfactory. The RMSD values for the RWEB and pan methods were obtained as 1.02 and 1.7, respectively. Therefore, the results indicate the good performance of the RWEB method. The RWEB sensitivity analysis showed that the model has the highest sensitivity to air and reference surface temperature and the least sensitivity to net radiation. Thus, evaporation from the body of water can be estimated accurately by precise measurements of air temperature and relatively reasonable estimations of the other parameters (reference and water temperature and net radiation).

Key Words: Doosti dam reservoir, energy balance, evaporation, reference surface.

DEVELOPMENT OF CDF, CFM AND CFCM METHODS FOR DAMAGE DETECTION IN THE MIDDLE OF BRIDGE DECKS

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Abstract
Structural damage detection has gained increased attention from the scientific community since unpredicted major hazards, most with human losses, have been reported. Aircraft crashes and catastrophic bridge failure are some examples. Security and economic aspects are important motivations for increasing research into structural health monitoring. Since damage alters the dynamic characteristics of a structure, namely, its Eigen properties (natural frequencies and modes of vibration), several techniques based on experimental modal analysis have been developed in recent years. In this article, a new method, based on developing the curvature damage factor method (CDF), change in flexibility method (CFM) and change in flexibility curvature method (CFCM) is presented. For this purpose, the three span Bozorgmehr Bridge, located in Esfahan, Iran, and a five-span bridge previously designed by an expert are used. The numerical model of the Bozorgmehr Bridge is verified by comparing the five primary natural frequencies with those obtained from experimental testing. In applying these methods, the mode shapes and natural frequencies of the damaged and undamaged bridges, are used. Damage is created on an element located in the middle of the deck. The four levels of damage considered are 15%, 30%, 70% and 90% reduction in the module of elasticity. It is shown that if mode shapes, as previously are simply extracted from one longitudinal section, the methods cannot always detect the damaged cross sections or the damaged longitudinal sections. But, if as shown in this article, the mode shapes are obtained from several longitudinal sections, these methods will be able to assess the damaged cross sections as well as the damaged longitudinal sections. It is also concluded that, when using the CDF method, the maximum content of CDF calculated for cross sections on itself cannot always show the damage locations. and it is necessary to consider the changes in value of CDF for several longitudinal sections too and, then, decide about damage locations.

Key Words: Damage detection, bridge, mode shape, natural frequency.

THE INFLUENCE OF THE RATIO OF THE ELASTIC MODULUS OF MASONRY MATERIALS TO FILLED MATERIALS ON THE RETROFITTING OF EXTERNALLY REINFORCED ARCH MASONRY BRIDGES

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Abstracts of Papers in English

ESTIMATING EVAPORATION FROM DAM RESERVOIRS BY DEVELOPMENT AND APPLICATION OF A NEW METHOD BASED ON ENERGY BALANCE CASE STUDY: DOOSTI DAM

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Abstract

Evaporation from bodies of water, like lakes and reservoirs among other natural evaporating surfaces like canopies and wet soils, constitutes a significant source of water loss affecting global water balance and energy exchange between land and atmosphere. Hence, formulating lake evaporation rates has been of great interest for many years and is definitely a challenge due to its complicated nature. Evaporation from lakes and reservoirs in Iran is commonly estimated using pan evaporation, which is well known to have significant uncertainty both in magnitude and timing. Reservoir operation and development of a new storage and water accounting strategies require more accurate evaporation estimates, especially for drinking water in arid conditions. In this study, an attempt has been made to estimate evaporation from a body of water using a new approach based on an energy balance model. For this purpose, a new energy balance method for two surfaces was established using water (evaporating surface) and bare soil (non-evaporating surface) as references. Considering similar conditions for two surfaces, an identical aerodynamic resistance ratio was assumed for both. With this assumption, a new form of energy balance