Discrete Design of Urban Road Networks with Meta-Heuristic Harmony Search Algorithm†

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ABSTRACT

In this study, the discrete design of urban transportation networks is formulated as a nonlinear mixed integer programming problem and solved with meta-heuristic Harmony Search (HS) optimization technique. The traffic assignment problem, which represents the distribution of the traffic flows on the road network, is solved under user equilibrium manner using Generalized Reduced Gradient (GRG) method. The investment strategy, which minimizes total travel time on the network, is determined by considering the available budget. The proposed method is applied on two well-known example road networks in the literature. Results showed that the meta-heuristic HS based solution method could effectively be used for discrete design of urban transportation networks and the system performance of the road network, which is solved with this method, is improved by about 16%.

Keywords: *Discrete transportation network design, harmony search, generalized reduced gradient method, traffic assignment, optimization*

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Effect of Openings in Building Slabs on the Structural System Behavior†

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ABSTRACT

Openings having various shape and dimensions exist in the slabs of buildings due to architectural and mechanical considerations. There are various requirements and restrictions in the seismic codes related to dimensions of the openings, including the Turkish Seismic Code (TSC Requirements for buildings to be built in seismic zones, 2007).

The Turkish Seismic Code requires that slab openings in floors larger than 1/3 of the floor gross area should be avoided. Otherwise, irregularity type A2 occurs and the slab should be considered as a non-rigid diaphragm. Furthermore, it is required that proper transfer of seismic loads to vertical structural elements should be assessed. In this study, behavior of the reinforced concrete buildings with a certain ratio of openings in the slabs are examined; requirements of the seismic codes of various countries related to this irregularity including TSC 2007, are given comparatively, the definition of irregularities and discontinuities in slabs are presented and the corresponding parameters are given in detail. The results of the numerical analysis related to slab opening irregularity and the effects of the numbers of floors, beam continuity, seismic zone, soil type and rigid and non-rigid diaphragm behavior on the results and on the behavior of the structural system are presented in figures. Furthermore the effects of the location and ratio of the slab openings on the structural system are also investigated.

Keywords: *Reinforced concrete building, slab opening, structural irregularity, seismic code*

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Experimental Investigation of the Behaviour of the Laterally Loaded Short Piles†

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ABSTRACT

In this study, the behaviour of short rigid piles founded in sand subjected to a lateral load applied at a certain height above sand surface has been investigated. For this purpose, a series of small-scale model tests have been conducted both in loose and dense sand conditions. In the experimental studies, the effects of pile embedment length, pile diameter, the geometry of pile's cross-section and pile material on the lateral load capacity have been explored. The results obtained from experimental studies indicate that the relative ground density significantly affect the lateral load capacity. However, the equivalent circular area assumption used by existing analytical approaches produces conservative lateral load capacities, especially in loose sand conditions.

Keywords : *Lateral load, short pile, model test, sand*

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Effect of Slab Reinforcement on Negative Moment Capacity for R/C Beams at Interior Connections[†]

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ABSTRACT

In this study, a procedure to obtain interior R/C T-beam plastic hinge moment capacity, as accurate as possible, from moment curvature analyses is introduced. The procedure which is based on realistic material models and compared with experimental results considers nonlinear behavior of confined and unconfined concrete, steel strain hardening, reinforcement buckling and varying strain distribution of slab reinforcement. Analytical and experimental comparisons show that plastic hinge moment capacities of T-beams in negative bending is almost always underestimated using rectangular section (beam web) assumption or T-beam approach with effective beam width based on TS500-2000. In this study, two simple approaches have been derived to obtain the plastic hinge moment capacity of R/C T-beams in negative bending in a practical way. Plastic hinge moment capacities of T-beams in negative bending calculated with the proposed equations are compared to the capacity extracted from moment-curvature analyses and experimental results.

Keywords: *T-beams, slab reinforcement, effective slab width, moment-curvature, strain hardening, confined concrete*

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Landslide Early Warning System Suggestion Based on Landslide - Rainfall Threshold: Trabzon Province†

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ABSTRACT

Knowing the duration, intensity and amount of precipitation that triggers landslides is of great importance for understanding landslide forecasting and landslide early warning systems. In recent years, studies carried out by the researchers exhibited that the rainfalls triggering landslides occur above a certain threshold value. In this study, the threshold value for Trabzon province where most landslides occur in Turkey was estimated, and a landslide early warning system was suggested depending on this threshold. In the study, 1105 landslides data occurred in the Trabzon province between the years 1988-2010 were used. Based on the rainfall thresholds obtained from different criteria, a landslide early warning database was prepared, and this database has provided positive results in a 2-year trial period.

Keywords: *Landslide early warning, rainfall threshold, Trabzon landslides*

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Torsional Behavior of Eccentrically Inverted V Braced Frames†

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ABSTRACT

Torsional irregularities are one of the most frequently observed reasons of serious damages. The effects of torsion mainly emerge in irregularly designed structures while in some regularly designed ones, they can appear as a result of construction fault. In this study, the effects of torsion on capacity of unbraced frames and eccentrically braced inverted V frames were investigated experimentally and numerically. Within the scope of the study, one span, two-storey, symmetrical systems in plan made out of box-sectioned members were examined. In these systems, in order to focus on torsional irregularities arising from different reasons, two types of load eccentricities were considered. Under these loadings, frames were pushed until maximum displacement reached up to 9 % of the frame height or up to the collapse of the system. The results obtained from eccentric loadings were compared to those obtained from symmetric loading.

Keywords: *Inelastic torsional behavior, inverted V braced frames, experimental research*

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Story Drifts and Connection Rotations of Semi-Rigid Steel Frames†

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ABSTRACT

Story drifts, connection rotations and story drift-connection rotation relationships of 6 partial strength/semi-rigid and 2 rigid frames having 7.0m and 9.0m span lengths and four different connection capacities are investigated with nonlinear dynamic analyses. In dynamic analyses 25 real ground motion records with 2 different earthquake levels and 9 far field and 9 near field artificial records are generated by using three different attenuation relations and scaled to 2 different earthquake levels are used. As a result of the analyses, the story drift ratios and the connection rotations of the frames are determined and their performance limit controls are performed and the story drift ratios of partial strength/semi rigid frames and rigid frames are compared. Finally, the story drift–connection rotation relationships are investigated and the effect of connection capacity, connection hysteresis model and the distance from the fault are searched.

Keywords: *Partial strength/semi-rigid connection, dynamic analysis, real and artificial record, story drift ratio, connection rotation*

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Experimental and Numerical Modeling of Submerged Hydraulic Jump Downstream of a Sluice Gate†

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ABSTRACT

The flow profile in an open channel model with submerged hydraulic jump downstream of a vertical sluice gate is measured for flow cases with Fr_1=1.77 and 1.35. The governing equations are numerically solved using Finite Volume method for the flows having the same conditions with experiments. In the numerical simulations, Standard k-ε, Renormalization-group k-ε and Realizable k-ε turbulence closure models are employed. Experimental validations of the numerical results show that computations using Renormalization-group k-ε turbulence model are the most successful, among the three, in predicting the free surface of the flow and the geometry of the submerged hydraulic jump.

Keywords: *Submerged hydraulic jump, finite volume method, VOF method, turbulence closure models, flow profile*

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A New Method for Determining Saturation Flow Depending on Driver Behavior†

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ABSTRACT

Saturation flow is a basic parameter used in design of signalised intersections. Uncertainties in determining saturation flow causes some deficiencies in calculation of capacity and level of service. HCM suggests two methods for determining saturation flow; analytical and observational, which are very common all over the world. Analytical method uses factors effecting saturation flow as coefficents. On the other hand, effects of driver behavior are not clearly included. In this study, initially a new analytical modelling based on driver behavior is presented; then the results are compared with field studies and HCM method. The results of the recommended method are found encouraging.

Keywords: *Saturation flow, signalized intersection, capacity, driver behavior*

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Upgrading Power Generation Using Supplementary Storage†

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ABSTRACT

Sustainable development of renewable energy sources gains increasing importance because of climatic changes and environmental problems. Hydroelectricity is the most commonly used type of renewable energy throughout the world. Development of proper and environmentally-friendly hydropower schemes should have a priority. This study deals with discussion of benefits and cost of a supplementary storage to an existing plant in Turkey. The proposed supplementary facility is composed of a small gravity dam, uncontrolled overflow spillway and a sluiceway. It is intended to utilize maximum benefit from the stored water. It will also enable increasing the profitability of the plant by shifting the energy generation scheme to the maximum demand periods. Cost-benefit analyses have been performed for various combinations of the structural components of the proposed facility. It was eventually observed that the proposed facility provided marginal benefits to the existing plant.

Keywords: *Storage, hydroelectric power plant, energy, power, benefit, cost*

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Derivation of Analytical Fragility Curves for RC Buildings Based on Nonlinear Pushover Analysis[†]

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ABSTRACT

Fragility curves are widely used in estimation of various damage states that may occur in buildings during possible earthquakes. In this study, analytical fragility curves are derived by considering architectural and structural details of three to eight story reinforced concrete buildings, which constitute the major part of the existing building stock in the city of Izmir and are used for residential purposes. Nonlinear static analyses are performed by generating 3D models of the buildings. Spectral displacement demand of the buildings is determined for different earthquake levels, which are defined in the Turkish Seismic Design Code-2007. Four limit states are defined for each building class in terms of spectral displacement. The fragility curves, which reflect general characteristics of the existing building stock and are expressed in the form of two-parameter lognormal distribution functions, are presented as an outcome.

Keywords: *Existing building stock, reinforced concrete buildings, pushover analysis, damage limit state, analytical fragility curves*

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Effects of Compaction Method and Aggregate Properties on Mechanical Behavior of Granular Base Layer†

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ABSTRACT

The aggregate properties and their compaction degrees are the two most important factors that have significant effects on the design of granular highway base layers. The effects of impact compaction and vibratory compaction methodologies on the gradation, physical and mechanical properties of graded aggregate base (GAB) layers were observed in the current study. Sieve analysis, California bearing ratio (CBR) tests and resilient modulus tests were conducted on four different GAB materials. Results indicated that the vibratory compaction methodology displays no significant damage on the shape of the aggregates.

Keywords: *Impact compaction, vibratory compaction, resilient modulus.*

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Modal Parameter Estimation of Model Steel Bridge Using System Identification Methods†

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ABSTRACT

Civil engineering structures are exposed to different external effects which change their dynamic characteristics. The fact that damage can alter stiffness, and/or energy dissipation capacity of a structure which in turn results in detectable changes in its vibration signature is the underlying principle of vibration-based structural health monitoring (SHM). An important step of SHM process is the estimation of modal parameters. In this study, modal parameters of a steel bridge are estimated using ERA and NExT-ERA system identification techniques. A calibrated finite element model of the bridge is obtained using the estimated modal parameters. Accurate damage identification of a structure depends on accurate estimation of modal parameters. The calibrated model in the future can be used to assess the parameters affecting modal parameter estimation therefore accurate damage identification.

Keywords: *Estimation of modal parameters, steel model bridge, system identification, experimental/operational modal analysis, structural health monitoring*

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Investigation of Shear and Overturning Safety of Hinged Connections in Existing Precast Buildings†

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ABSTRACT

In the last two decades, as a result of earthquakes, one storey precast buildings that represent the majority of industrial building stock of Turkey have been damaged significantly. Reconnaissance studies have shown that as well as insufficient stiffness and ductility capacities of buildings, low shear and overturning resistance of hinged connections are the common causes of damage in precast construction. In order to concentrate on connection problems in existing precast buildings, Denizli Organized Industrial Zone, which is one of the important industrial zones of Turkey, was selected. During inventory studies structural properties of precast buildings were determined. Details of hinged connections were obtained from building inventories and shear and overturning capacities of connections were calculated. Seismic resistance demands in connections were calculated by using 40 acceleration records selected from real earthquakes. Shear and overturning demands were then obtained by using non-linear time history analyses and safety of connections was determined. During these studies capacities and demands were compared using the force based approach. Results have shown that overturning of roof girder failure yields a more critical situation with respect to shear failure of connection. It is also determined that shear and overturning safety of connections decreases depending on the increasing strength and stiffness capacities of buildings.

Keywords: *Precast buildings, seismic performance, shear safety of connections, overturning safety of connections.*

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Investigation of Factors Affecting Discharge Capacity of Prefabricated Vertical Drains†

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ABSTRACT

An important factor affecting the performance of PVDs is their discharge capacity. The effect of factors such as, the hydraulic gradient, lateral stresses on a PVD, the type of soil in which PVDs are placed, the structure of PVDs and their flexural stiffness were investigated. Four different types of PVDs were used to investigate the effects of PVD deformation during the consolidation of soil and clogging of the core area on the discharge capacity of PVDs. The discharge capacity of PVDs, which is large at low deformations, decreases significantly (up to 57%) within the range of hydraulic gradients applied in this study (0.10 to 1.00). At large deformations, PVDs have a lower discharge capacity although the change in hydraulic gradient has a negligible effect on them. On the other hand, experimental observations have shown that the deformations occurring during consolidation of soils have an important effect on the discharge capacity of PVDs. For the type of PVDs used, the discharge capacity decreases by 68% to 100% when PVDs deform by 41.5%. Furthermore, a 40% decrease in discharge capacity is observed when lateral stress is increased from 25 kPa to 200 kPa. Clogging of the core zone, shapes of deformation, structure of PVD, and resistance against buckling have varying effects on the discharge capacity of PVDs depending on the soil type.

Keywords: *Prefabricated vertical drain, model testing system for discharge capacity, discharge capacity of prefabricated vertical drains.*

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Determination of Bed Friction Coefficient and Bottom Slope At Flow Gauging Stations Using A Numerical Method†

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ABSTRACT

In this study, measured flow data obtained from natural streams is utilized to predict hydraulic characteristics and to validate conformity of the measured data sets. Section factor is computed from cross-section measurements. Relations between section factor and water depth are derived from synthetically enriched data based on measurements at high water levels. Bed friction and bed slope are determined by fitting logarithmic wall functions to measured point velocity data. Thus, it is shown that it can be possible to obtain more technical information from the traditional flow measurement data.

Keywords: *Flow measurement station, uniform flow, bed slope, bed friction coefficient.*

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