unrealistic predictions of the response and strength of steel structures.
The objective of the current study is to evaluate the effects of this partial rigidity of the beam-to-column connection on the actual behavior of steel frame buildings. Particular attention is devoted to double web angle connections and top and seat angle connections, which are customary types used in most practical cases. In this paper, some basic concepts related to the beam-to-column connection, such as fixity percentage and end fixity factor, are illustrated in detail and then calculated for customary steel frames. For this purpose, particular classes of braced steel buildings, those composed of three, five and eight stories with different span length, are modeled as 2-D frames, and nonlinear static analysis is performed. According to the results, connection fixity quantities are less than 10 percent. Also, some changes in element forces occurred due to the actual semi-rigid behavior of flexible connections. Generally, considering the nonlinear behavior of connections in braced simple steel frames, the designing forces of beams decrease (up to 18 percent in our models), and the designing forces of columns increase. These increases in the designing forces of outer columns, especially in upper stories, are noticeable.

**Key Words:** Simple steel frame, beam-to-column connection, partial rigidity, web angle, seat angle.

sponse of a SDOF system with a damping ratio of 5% equals the codified template design spectrum.

**Key Words:** Acceleration functions, endurance time, wavelet transformation, optimization algorithms.

## EXPERIMENTAL INVESTIGATION ON CYCLIC BEHAVIOR OF RC JOINTS USING NOVEL MANUALLY MADE FRP SHEAR REINFORCEM -ENT COMPARED TO CONVENTI -ONAL STEEL STIRRUPS

**M. K. Sharbatdar**(corresponding author)
msharbatdar@semnan.ac.ir
**A. Dalvand**
ahmad.dalvand@gmail.com
**Dept. of Civil Engineering**
**Semnan University**
**M. Jalali**
mei_jalali@yahoo.com
**Dept. of Civil Engineering**
**Damghan University**

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**Abstract**
One of the most important defects occurring in reinforced concrete structures is the corrosion of reinforcements under undesirable environmental conditions. Various innovative methods have been studied by different researchers to prevent corrosion. If a typical concrete structure, reinforced by steel rods, encounters corrosive environments like salts, acids and chlorides for a length of time, it will lose strength to some extent. In addition, the corrosion of the steel, which is located inside the concrete, might expand and damage it. Longitudinal rods have larger diameters compared to stirrups and, therefore, they demonstrate lower corrosion effects and are a better alternative. Stirrups with lower diameters and more proximity to the environment are subject to corrosion and, therefore, it is better to use FRP stirrups, which are resistant to corrosion. Precast stirrups have a special manufacturing process and are also expensive and rare. So, using them in small scale projects is not economic. Hence, it seems necessary to find a new method for manufacturing FRP stirrups that is economically viable as well as showing a good performance under external forces. The present research experimentally investigates replacing steel stirrups with stirrups made by FRP filaments under cyclic loads. So, three concrete connections were made and tested. A longitudinal reinforcement with steel stirrups was designed as the reference connection. Steel longitudinal reinforcements were used in all three connections. One specimen of FRP stirrup connections is exactly similar to the reference. As with the other two FRP stirrup connections, the space between the stirrups is twice that of the reference specimen. The stirrups in the last two specimens were made of FRP filaments, in the laboratory. The diagrams of moment-drift, moment-curvature and moment-strain have been obtained for steel and FRP stirrups. Energy absorption and hardness changes have been calculated for all three specimens. All three stirrups went under cyclic loads, and FRP stirrups showed a better performance compared to steel stirrups.

**Key Words:** RC Joint, FRP stirrup, panel zone, ductility.

## EVALUATION OF PARTIAL RIGIDITY OF SIMPLE STEEL FRAMES WITH ANGLE CONNECTIONS UNDER GRAVITY LOADS

**S. Bagheri**(corresponding author)
s_bagheri@tabrizu.ac.ir
**N. Vafi Tabrizi**
vafiei88@ms.tabrizu.ac.ir
**Faculty of Civil Engineering**
**University of Tabriz**

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**Abstract**
Generally, steel frames are classified as rigid, semi-rigid and flexible frames, according to their connection stiffness. But, in the analysis of steel frame buildings, it is customary to represent joint behavior by an idealized model, either as a rigid or as a pinned joint. However, typical connections in actual structures do not behave in either a perfectly rigid or a perfectly pinned manner. Previous investigations have shown that most connections in braced simple steel frames using angles do not behave in a perfectly pinned manner and exhibit some rotational stiffness. Consequently, an idealized pinned assumption for these types of connections can lead to

**A. Kheyroddin**
kheyroddin@semnan.ac.ir
**Dept. of Civil Engineering**
**Semnan University**

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**Abstract**

By increasing the number of earthquake records, it has been made obvious that the dynamic characteristics of ground motion between different stations (even stated in a specific zone) are considerably different. This distinction is further highlighted in surrounding areas due to the epicenter. Seismic events all over the world have shown that ground motion in the vicinity of causative faults (within a distance of 15 km from the fault) may be categorized as a large-velocity pulse and a large-displacement fault, which have the potential to cause considerable structural damage. Consequently, the main cause of long-period pulse formation is the cumulative effect of shear wave propagation along the fault rupture, according to seismological investigations. Near-fault ground motion is severely affected by fault mechanisms, rupture propagating directions relative to the site and, finally, the permanent deformation of the ground. These parameters create two significant effects; directivity and the fling step, which should be taken into account when estimating ground motion in the vicinity of causative faults. Forward-directivity depends on the rupture mechanism and slip direction relative to the site. It is characterized by a large pulse occurring at the initiation of the record and oriented in a perpendicular direction relative to the fault plane. In contrast, the fling-step is affected by tectonic deformation in the fault and commonly generates permanent static displacement, which occurs parallel to the strike of the fault for strike-slip events, and normal-to-fault direction for dip-slip earthquakes. In this study, an innovative mathematical model is developed for the prevalent pulse modeling of near-fault records during the 1978 Tabas and 2003 Bam earthquakes. The proposed model is capable of simulating the long-period portion of near-fault records with a high level of precision. Simulated pulses for the ground motion components of the Bam earthquake and their elastic response spectra have good compatibility with that of actual records. Furthermore, the generated elastic response spectra for the simulated pulse and corresponding characteristics for actual records of the Tabas earthquake indicate good agreement just for long-period areas.

**Key Words:** Near-fault, prevalent pulse, elastic response spectra, ground motion.

# GENERATION OF ENDURANCE TIME ACCELERATION FUNCTIONS WITH WAVELET TRANSFORM AND OPTIMIZATION ALGORITHMS

**A. Kaveh**(corresponding author)
alikaveh@iust.ac.ir
**Dept. of Civil Engineering**
**Iran University of Science and Technology**
**V.R. Mahdavi Dahoee**
vahidreza_mahdavi@civilEng.iust.ac.ir
**Dept. of Civil Engineering**
**Iran University of Science and Technology**

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**Abstract**

Wavelet transform is a mathematical tool which indicates the time variations of frequency in a signal. On the other hand, the endurance time method is a new dynamic pushover procedure where the performance is assessed based on the length of the time interval needed to satisfy required performance objectives. In this paper, endurance time acceleration functions (ETAF) are generated for the compatible design spectrum of standard No. 2800 for soil type (II) with wavelet transform and optimization algorithms. To generate endurance time functions, in the first step, wavelet analysis is performed to decompose a series of random data to several levels, each level covering a special range of frequencies. Each level is then divided into a number of equal time intervals and each interval of time is multiplied by a variable. Unconstrained optimization algorithms are used to calculate the variables and minimize the error between the response and the target spectra.

The method applied is a modification of the data in the time and frequency domain. For this purpose, the efficiency of the heuristic algorithm (GA), the classic algorithm (quasi-Newton algorithm) and their combination, for the simplified objective function (duration of this objective function is 5.12 seconds, which consist of 512 acceleration points in 0.01s time steps) is evaluated. The algorithm which determines the minimum error in the specified iteration is selected as the best method to optimize. Employing this optimization method, the main acceleration function (duration of this objective function is 20.48 seconds, which consist of 2048 acceleration points in 0.01s time steps) is produced. Finally, error values of the acceleration functions produced are compared with ETA20d acceleration functions. The target time of the functions is 10th of a second when the re-

tional and translational motions. Using the mentioned approach, it becomes possible to consider frequency dependent wave velocities and the incident wave angle of the earthquake to generate the rotational components of ground motion. For this purpose, two translational components of different earthquake accelerations have been adopted to generate their relative rotational components, based on SV and SH wave incidence. The results are compared with other work and show very good agreement. Using translational and obtained rotational components of ground motion, a dynamic analysis of the Pine Flat dam has been performed for six earthquake accelerations. Analyses have been done using the finite element method, considering dam-reservoir interaction. The dam and reservoir are modeled using a Lagrangian approach, and different water levels of the reservoir are considered. The material behavior of the dam and reservoir is considered to be elastic, linear, isotropic and homogeneous, and, also, the foundation is assumed to be rigid. Results are shown that depend on maximum rocking components and their frequency content. Content, these components can be effective on the linear dynamic response of concrete gravity dams and cannot be negligible in some cases.

**Key Words:** Rotational components of earthquake, frequency dependent wave velocity, dam-reservoir interaction, Lagrangian-Lagrangian approach.

## HORIZONTAL STRESS ESTIMATION USING CPT: A DATABASE APPROACH

**M.M. Ahmadi**(corresponding author)
mmahmadi@sharif.ir
**P. Karambakhsh**
pooya_karambakhsh@yahoo.com
**A.A. Golestani**
ali_akbar_golestani@yahoo.com
**Dept. of Civil Engineering**
**Sharif University of Technology**

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**Abstract**

In order to perform a stress-deformation analysis of a geotechnical system, it is essential to know the in-situ stress state of the ground. The in-situ vertical stress can be simply determined if the depth and the soil density are known. However, it is more difficult to determine the in-situ horizontal stress. This is because it depends on several other soil characteristics, such as stress history and over consolidation history.

Throughout the years, several additional sensors have been developed in order to supplement the data collected with the CPT test. Among the wide variety of sensors developed, the lateral stress module represents a promising tool for estimation of in situ lateral stress conditions from the interpretation of lateral stress penetration data. However, the popularity of the so called lateral stress cone has declined over the years due to constraints in both the instrumentation and the interpretation of measured data.

In the present paper, a database of calibration chamber tests results is provided. Using the database, the effects of different soil parameters (such as relative density, in-situ vertical stress, in-situ horizontal stress, constraint modulus, and over consolidation ratio) on cone tip resistance have been studied.

Among these parameters, relative density and in-situ horizontal stress are found to be the main effective parameters and a correlation between these parameters and cone tip resistance has been suggested. With a given relative density, the relationship can be used to estimate the in-situ horizontal stress of the soil upon measured cone tip resistance.

The relationship has been validated with calibration chamber test database. Besides, its effectiveness has been compared with two other empirical correlations suggested by other researchers. The results indicate that the correlation proposed in this study can predict cone tip resistance better than the other two available correlations.

**Key Words:** CPT, calibration chamber, cone tip resistance, relative density, horizontal stress.

## PREVALENT PULSE MODELING FOR NEAR-FAULT RECORDS DURING 1978 TABAS AND 2003 BAM EARTHQUAKES

**S.R. Hoseini Vaez**
hoseinivaez@qom.ac.ir
**Dept. of Civil Engineering**
**University of Qom**
**G. Ghodrati Amiri**(corresponding author)
ghodrati@iust.ac.ir
**Dept. of Civil Engineering**
**Iran University of Science and Technology**
**M.K. Sharbatdar**
msharbatdar@semnan.ac.ir
**H. Naderpour**
naderpour@semnan.ac.ir

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**Abstract**

The importance of non-structural components in the seismic performance based design of buildings is well known nowadays. Impaired Non-Structural Components (NSC) in earthquakes could cause heavy loss of life and property and loss of serviceability. The response of NSC depends on various parameters, among them are the behavior of the primary structure, location of non-structural elements in the structure, interaction between NSC and the structure, type and number of NSC attached points, the geometry, shape and condition of the mass distribution of NSC and etc. Researchers have used different methods for calculating NSC responses. Among them are the direct method and the Floor Response Spectrum (FRS) method. In the first method, analysis is performed by modeling the primary structure and NSC simultaneously. In case the weight of the NSC is less than 10% of the total weight of the structure and 20% of the weight of the floor, then, the effect of NSC on the structure can be neglected and simpler methods can be implemented. One of the simpler methods is the FRS method. In this method, the behavior of the primary structure at the attached point or points of NSC is determined, neglecting their interaction. Then, the obtained FRS is used as an input for analyzing non-structural elements. This method is used in many design codes in order to determine the design force on the NSC. The present research studies the effect of various parameters, including the inelastic behavior of the system, natural periods of primary and secondary systems and type of structural system, on NSC response. A method for calculating the NSC response is suggested, which accounts for the location of the NSC and the inelastic behavior of the structure more precisely. For this research, a variety of moment resisting frames, eccentric and concentric braced frames were examined. These frames are designed in accordance with ASCE 2005 requirements. 15 records of far-field earthquakes and 15 records of near-field earthquakes were chosen for performing parametric studies. To perform expanded parametric studies on various frames with different stiffness and strength, modified shear building models for these frames were constructed. The shear building frame is set to have an equivalent lateral force-deformation behavior in each storey of a given MRF, CBF or EBF frame. Consequently, the base shear-roof displacement curve of both frames became approximately the same. It has been demonstrated that the structure system type does not significantly affect the suggested relations. Moreover, in this study, it has been shown that earthquake intensity causes minimum acceleration (in the first floor) to decrease, and peak acceleration (in higher floors) to increase.

**Key Words:** Non-structural components, earthquake intensity, shear building, near-field effects, floor response spectrum.

## EFFECT OF ROTATIONAL COMPONENTS OF EARTHQUAKES ON DYNAMIC RESPONSE OF CONCRETE GRAVITY DAMS CONSIDERING RESERVOIR INTERACTION

**L. Kalani Sarokolayi**
l.kalani@stu.nit.ac.ir
**B. Navayi Neya**(corresponding author)
navayi@nit.ac.ir
**J. Vaseghi Amiri**
vaseghi@nit.ac.ir
**H. R. Tavakoli**
tavakoli@nit.ac.ir
**Dept. of Civil Engineering**
**Babol Noshirvani University of Technology**

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**Abstract**

Rotational components of ground motion including rocking and torsional components have been eccentrically ignored for a long time, first, because the rotational effects were thought to be small for structures and, second, due to their small amplitude, they cannot be measured using standard seismic devices. Recently it has been shown that the rotational component of ground motion can have noticeable effects on the dynamic response of structures, and many structural failures and the damage caused by earthquakes can be linked to differential and rotational ground motion. The main purpose of this paper is presentation of a proper formulation for dynamic analysis of concrete gravity dams under the correlated translational and rotational components of ground motion due to earthquakes. The rocking component of earthquake acceleration has been obtained using the corresponding available translational components, based on transversely isotropic elastic wave propagation in 2-D space and the classical elasticity theorem between rota-

The model assumes the open-cell foam to be constructed from a repetition of the same unit-cell. The unit-cell in its original state has a regular structure, i.e. it comprises four identical members forming equal angles with respect to each other; the point at which these members coincide is called the unit-cell vertex. Imperfection was introduced in the form of small perturbations in the position of the unit-cell vertex. Accordingly, homogenization was employed to obtain the uniaxial stress-strain response of various perturbed microstructures. The results were then quantified in terms of four uniaxial parameters. The next step was to compare these parameters with their counterparts that had been obtained for the regular microstructure. The consequence of this was to identify how the uniaxial response of originally regular, open-cell foam could vary when its microstructure was subjected to geometrical imperfections. In particular, this investigation revealed that different uniaxial parameters altered linearly (or pseudo-linearly) as the perturbation of the microstructure increased.

**Key Words:** Constitutive modeling, homogenization, open-cell foams, geometrical imperfection.

## CONNECTION OF PRECAST REINFORCED CONCRETE FLEXURAL MEMBERS USING ULTRA HIGH PERFORMANCE CONCRETE (UHPC)

**M. Rakhshanimehr**
rakhsh_77@yahoo.com
**M. R. Esfahani**(corresponding author)
esfahani@um.ac.ir
**Dept. of Civil Engineering**
**Ferdowsi University of Mashhad**
**S. R. Mousavi**
s.r.mousavi@endg.usb.ac.ir
**Dept. of Civil Engineering**
**University of Sistan and Baluchestan, Zahedan**

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**Abstract**
Ultra High Performance Concrete (UHPC) is an excellent material for the creation of filigree components. Its high ductility and endurance make it the ideal replacement for other materials, such as steel, in many areas. Ultra high performance concrete has very high endurance due to its low capillary porosity. Its high resistance to deicing salt makes it an interesting choice for use in surfaces frequently exposed to deicing salt. Ultra high performance concrete (UHPC) has the potential to greatly simplify construction joints in accelerated bridge construction by reducing the development length of reinforcing steel. The use of UHPC in highway bridges has recently begun in the connection between modular precast components. The potential for increased safety and quality that comes from the use of prefabricated components is enticing; however, there is also the recognition that the use of these components frequently necessitates the use of field cast connection details. Conventional construction practices for such connection details can result in reduced long-term connection performance compared to joined components.
In this study, the bond strength between UHPC and reinforcing bars is investigated using pullout and spliced beam specimens. Thirty six pullout specimens and ten beam specimens were manufactured and tested. The effects of different properties such as concrete cover and top bar effect on bond strength are studied by pullout tests. The strength and ductility of 9 full scale flexural beams fabricated from two precast components and joined together with UHPC are investigated. The bond strength of spliced bars in joints is the main parameter of this investigation. One beam without spliced bars was cast as a reference specimen. Mid-span displacement and the applied load were obtained using a hydraulic jack, a load-cell, a LVDT and a data logger set. The load versus displacement relationship of beams was determined using the experimental data. A ductility ratio was used to evaluate the ductility of the specimens. Comparison between the load-displacement relationship and the ductility ratio of different specimens indicates that using UHPC in the connecting region of precast members leads to simplification of the connection details without loss of ductility and flexural strength of the beams.

**Key Words:** Bond strength, connection, ductility, precast members, splice length, UHPC.

## A PARAMETRIC STUDY ON INPUT ACCELERATION FOR THE DESIGN OF NON-STRUCTURAL COMPONENTS

**R. Karami Mohammadi**(corresponding author)
rkarami@kntu.ac.ir
**M. Mohammadi**
m0.mohammadi@yahoo.com
**Dept. of Civil Engineering**
**K.N.Toosi University**

# FINITE ELEMENT MODELING CONFINED MASONRY WALLS CONSTRUCTED BASED ON IRANIAN SEISMIC CODE

**S. Eshghi**(corresponding author)
s.eshghi@iiees.ac.ir
**B. Sarrafi**
b.sarrafi@iiees.ac.ir
**International Institute of Earthquake Engineering and Seismology (IIEES)**

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**Abstract**

Confined masonry walls are made up of masonry walls and confining elements on their four sides. This system is a conventional form of housing construction, as well as a good alternative for post-disaster reconstruction of seismically damaged and/or collapsed buildings in many countries, including Iran. Seismic behavior of confined masonry buildings rigorously depends on material properties, construction methods and worker skill levels. There are few studies that consider the effects of the local constructing parameters of Iran, such as common materials and labour skills, on the modeling of confined masonry walls. In this paper, a computer program, DIANA, is used for the finite element modeling of confined masonry walls. Modeling parameters are estimated by material tests conducted in the structural laboratory of the International Institute of Earthquake Engineering and Seismology (IIEES). The models are validated with the results of tests performed on two one-story one-bay confined masonry walls performed in the same laboratory. The walls are designed according to the Iranian seismic code and are subject to lateral cyclic loading; the first being solid and the second with a central window opening. The scale of 1:2 is assigned to all parts of the walls including bricks. Two types of mortar with different sand to cement ratio are used to make the masonry walls. Proper modeling parameters for concrete ties and the macro modeling of masonry panels, which are estimated by material tests, are introduced for both specimens. The results obtained from the models match the experimental results quite well. Results show that the elasticity module of such walls are considerably smaller than that proposed in previous studies in foreign counties. Also, results indicate that changing the sand to cement ratio of mortar can affect the lateral resistance of walls significantly. So, it can be concluded that this ratio should be addressed in the Iranian codes.

**Key Words:** Finite element modeling, confined masonry walls, Iranian standard no.2800.

# EFFECT OF GEOMETRICAL IMPERFECTION OF THE MICROSTRUCTURE ON THE UNIAXIAL BEHAVIOR OF OPEN-CELL FOAMS

**S. Jalilvand**
s_jalilvand@mehr.sharif.ir
**Dept. of Civil Engineering**
**Sharif University of Technology**
**S. Shahbeyk**(corresponding author)
shahbeyk@modares.ac.ir
**Dept. of Civil and Environmental Engineering**
**Tarbiat Modares University**
**A. Vafai**
vafai@sharif.edu
**Dept. of Civil Engineering**
**Sharif University of Technology**

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**Abstract**

Solid foams are novel materials with outstanding characteristics that have found numerous applications in the construction of light, stiff structures during the past two decades. At the micro-level, solid foams benefit from a cellular structure, which is composed of either closed or open cells. Open-cell foams, which were investigated in this study, are described as a network of inter-connected struts (or ligaments) with beam-like action. The mechanical design of foams requires their mechanical properties to meet certain criteria. These criteria can be satisfied by careful selection of the base material and the microstructural geometry. However, the selected material has to be manufactured, and manufacturing is by no means a perfect process. As a result, there is always a threat that the properties of the final material differ from the ones expected. The current study addresses this issue by exploring the effect of geometrical imperfections on the uniaxial properties of regular open-cell foams. Such an investigation requires an appropriate approach, capable of relating the microstructural characteristics to the effective behavior of the material. An existing homogenization model was used for this purpose.

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**Abstract**

Soil-Foundation-Structure Interaction (SFSI) in a structural modelling procedure can change seismic structural response. However, SFSI effects are mostly ignored in the analysis procedure of structures, due to a general engineering belief regarding its conservative effects. This conservativeness is not always the case, although the period and the damping of the structure changes by considering the SFSI effects and, consequently, seismic demand decreases. Consideration of SFSI effects still contains some level of difficulty due to the needed in advance modelling procedures, but this issue can be solved by employing advanced finite element modelling programs, e.g; OpenSees software.

The aim of the current paper is to evaluate the influence of SFSI effects on the component demand modifier factor, based on Iranian instructions for the seismic rehabilitation of existing buildings. For this purpose, the beam on the nonlinear Winkler foundation approach is used, which is a simple and efficient method. First, a collection of 3, 6, 10 and 15 storey concrete moment-resisting frames, founded on soft, medium and hard soil, are designed and analysed for the case of fixed-base and flexible-base assumptions. Eight ground motion records were chosen in order to estimate the median response of frames for a pre-defined seismic scenario.

A comparison has been made between the results of the nonlinear response history analysis of each frame under flexible-base and fixed-base conditions, with the response based on the equivalent linear static approach. The results show that the equivalent linear static approach load combinations for the elements with significant gravity loads that are controlled by deformation actions (e.g. beams) can lead to non-conservative prediction of the seismic demand. Finally, a new load combination has been proposed in order to limit the influence of the demand modifier factor only on the seismic loads. This new proposed load combination can be used to improve the equivalent linear static approach in the instructions for seismic rehabilitation of existing buildings.

**Key Words:** Soil-foundation-structure interaction, modelling, Winkler, flexibility, ground motion.

## AN EXACT FREE VIBRATION SOLUTION OF ISOTROPIC SIMPLY SUPPORTED THICK RECTANGULAR PLATES USING DISPLACEMENT POTENTIAL FUNCTION

**B. Navayi Neya**
navayi@nit.ac.ir
**Dept. of Civil Engineering**
**Babol Noshirvani University of Technology**

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**Abstract**

In this paper, using displacement potential functions, the exact solution of a three dimension elasticity problem is presented for free vibration of rectangular isotropic plates. It is assumed that the materials of the plate are homogeneous, linearly elastic, arbitrary, but with a constant thickness, and all four edges of the plate are on simple supports. The governing equations in terms of displacement potential functions are two differential equations of fourth and second orders. Assuming harmonic motion and using a separation of variables, the solution of the governing differential equations for displacement potential functions results in exponential and trigonometric expressions along the plate thickness and the other two lengths, respectively. The boundary condition are zero vertical displacement and zero bending moments on all four edges, and all components of stresses, including normal and shear stresses on the top and bottom of the plates, are zero. Applying these boundary conditions result in a characteristic equation of the free vibration of the plate, with which solution, the plate frequency vibration can be calculated. In order to verify the solutions, the obtained results are compared with other analytical work that are largely based on first and higher order deformations theories for moderately thick plates. The most important characteristic of the method presented in this paper is that there is no limitation for thickness in determining free vibration frequency and its validation for thin, moderately thick and thick plates. The investigations have been done for a wide range of aspect ratio (length to width) and thickness to length. The obtained results show that increasing plate thickness decreases nondimensional frequency, and that this decrease intensifies at higher modes of vibration. In addition, investigations show that the Poisson's ratio has little effect on nondimensional frequency increasing the thickness of the plate. This phenomenon is negligible when the thickness of the plate is decreased.

**Key Words:** Exact solution, thick rectangular plates, displacement potential function, free vibration, three dimension elasticity problem.

decrease the solubility of carbonate and consequently increase the efficiency of contaminant removal by EDTA from calcareous soils. In addition, according to the results of this paper, several soil washing with low concentrations of EDTA will not significantly decrease the soil pH. Therefore, the soil buffering capacity will remain constant in this method of soil remediation. In fact, in such a case, the remediated soil will keep its retention capability after the remediation process.

**Key Words:** Kaolinite, carbonate, geo-environmental engineering, heavy metal, Pb, EDTA.

## SEISMIC EVALUATION OF BUCKLING RESTRAINED BRACED FRAMES BY UTILIZATION OF THE SCALED NONLINEAR DYNAMIC PROCEDURE

**G. Ghodrati Amiri**(corresponding author)
ghodrati@iust.ac.ir
**E. Darvishan**
darvishan@iust.ac.ir
**School of Civil Engineering**
**Iran University of Science & Technology**
**Farhad Rahgozar**
farhadrahgozar@gmail.com
**Dept. of Civil Engineering**
**University of Shomal, Amol**

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**Abstract**

Strong earthquakes during the last two decades and also post-earthquake field investigations have revealed that steel braced frames exhibit non-ductile behavior due to the buckling of braces during severe ground motion. Recently, modified braces, namely; "buckling restrained braces" (BRB), have been proposed, in which the buckling of braces due to compression forces is prevented. Thus, such braces exhibit the same behavior in tension and compression. Since these braces have recently been proposed, more investigations into their seismic performance are needed.

Nowadays, the computational effort of computers has facilitated the implementation of nonlinear analysis procedures in structural engineering. Nonlinear dynamic analysis is the most exact method for seismic evaluation of structures. However, it is time-consuming and complicated to be utilized in 5engineering practice. In contrast, static pushover analysis (SPO) is more practical, but, it has several limitations. Recently, a scaled nonlinear dynamic procedure (scaled NDP) has been proposed. In this procedure, dispersion of the responses of nonlinear dynamic analysis is reduced by scaling a few ground motion records. Ground motion records are scaled to a value equal to roof target displacements, which are obtained by a static nonlinear procedure. Therefore, this procedure is suitable for cases in which a sufficient number of ground motion records are not available. Recently, scaled NDP has been recognized by FEMA440 as an effective tool for the seismic evaluation of structures since it utilizes the benefits of both nonlinear dynamic and nonlinear static procedures.

In this study, the seismic behavior of buckling restrained braced frames is investigated using scaled NDP and a nonlinear static procedure. Two groups of BRBF structures including 3-story and 12-story frames with diagonal, x-split and chevron bracing configurations are designed, and seismic responses, including displacements, story drifts and story shears, are compared by scaled NDP and SPO analyses. To evaluate the accuracy of the scaled NDP procedure, the effect of the number of earthquake ground motion records on the dispersion of the results is also investigated. Results show that nonlinear static analysis is able to estimate relatively good results, although it overestimates the responses in some cases. Also, an increase in the number of earthquake ground motions does not considerably improve the dispersion of results.

**Key Words:** BRBF, nonlinear static procedure, nonlinear dynamic procedure.

## EFFECTS OF SOIL FOUNDATION STRUCTURE INTERACTION ON THE COMPONENT DEMAND MODIFIER FACTOR BASED ON INSTRUCTIONS FOR SEISMIC REHABILITATION OF EXISTING BUILDINGS

**A. Azarbakht**(corresponding author)
a-azarbakht@araku.ac.ir
**E. Rajabi**
elhamrajabi@ymail.com
**Dept. of Civil Engineering**
**University of Arak**

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# Abstracts of Papers in English

## BUFFERING CAPACITY VARIATIONS IN CALCAREOUS SOILS AND THE USE OF EDTA FOR REMEDIATION OF PB-CONTAMINATED CALCAREOUS KAOLINITE

**V.R. Ouhadi**(corresponding author)
vahidouhadi@yahoo.cam
**M. Safari-Zanjani**
m.s.zanjani@gmail.com
**Dept. of Civil Engineering**
**Bu-Ali Sina University**

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**Abstract**

In this paper, the influence of calcium carbonate (calcite) in kaolinite on the buffering capacity of clayey soils and soil contaminant remediation with EDTA is investigated. For this purpose, several mixtures of kaolinite and different percentages of carbonate were prepared and were laboratory contaminated with different concentrations of $Pb(NO_3)_2$. The kaolinite sample initially had 4% natural carbonate. To investigate the impact of carbonate on the soil interaction process with EDTA, 6, 11, 16, 21 and 26 percentages of calcite was added to soil samples. Therefore, different calcareous soil samples had 10, 15, 20, 25, and 30 percentage of calcite, respectively. Then, different concentrations of EDTA were applied to these samples in the EDTA/Pb ratios of 0.2 to 1. This range of EDTA is proposed by prior research. After the mixing period, the samples were centrifuged. Then, the concentration of Pb and Ca was measured in supernatant. The results show that in this method of soil remediation, due to the solubility of a part of carbonate in low pH, the buffering capacity of soil decreases. With the solubility of calcium carbonate and the release of calcium ions, both calcium and Pb ions will tend to interact with EDTA and form a Ca-EDTA or Pb-EDTA complex. This, in turn, will reduce the efficiency of soil remediation with EDTA. The results of this paper show that the use of EDTA, at low concentrations, with the application of several soil washing will