that the elastic stiffness of the specimens compared to the steel column with mid plate pass in the CFT connection, CFT connection with plate pass, steel column connection with top and bottom plates, CFT connection with top, bottom and mid pass plates, steel column connection with top, bottom, and mid plates, increase as 0.24, 0.28, 0.6, 0.09, 0.68, and 0.3, respectively. In addition to the mentioned results, the ratio of ductility of the specimens compared to the steel column with mid plate pass in the CFT connection, CFT connection with plate pass, steel column connection with top and bottom plates, CFT connection with top, bottom and mid pass plates, steel column connection with top, bottom and mid plates increase as 0.16, 0.2, 0.08, 0.02, 0.3, and 0.17, respectively.

Key Words: concrete filled tube (CFT) column, steel wall, ductility, confinement effect.

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Abstract

Prestressed reinforced concrete structural components are very commonly used in construction of civilian and military structures. The prestressed components, such as reinforced concrete columns, beams, and bridge decks, outperform the non-prestressed components because of the following reasons. A prestressed member has higher structural stiffness and more load bearing capacity as well as better crack resistance compared to non-prestressed ones.

This study focuses on effect of using prestressed cables in bridge piers. Different elements, such as the bridge height, prestressing loads, and compression capacity of concrete, are taken under investigation for a chosen sample case - "forg" bridge- located in south of Iran. To investigate the prestressed cables function in bridge piers with regard to aforementioned elements, the subject bridge is modeled in SAP software. After performing the spectral analysis, data for columns with and without the prestressed cables were collected. Acquired data were then analyzed using ABAQUS software. Results of this analysis show that prestressed concrete columns had less movement in all three axes (X, Y, and Z). Further studies also reveal that samples with prestressed cables had less damages compared to the non-prestressed ones. Studies also proved that increasing the prestressing load would result in less member displacements, less member defection, and also less stress in the section. These advantages are more effective in the direction of Y axis than the other axes. As for the effect of the structure height, samples from shorter columns tend to have minor damage and stress and, in general, better behavior in comparison to the samples from longer columns.

In addition, concrete compressive strength plays an important role in prestressed members behavior; however, uncontrolled increase in concrete compressive strength could have a negative effect on the structure behavior.

Key Words: Prestressed concrete, bridges, damage, displacement, life line.

THE THICKNESS EFFECT OF CONNECTION PLATE OF BEAM TO STEEL FILLED COLUMN WITH CONCRETE ON SEISMIC BEHAVIOR OF THE CONNECTION

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Abstract

In construction science, the combined use of different materials by considering their properties has a very long history. Such an approach has evolved with the changing needs and expectations of society worldwide. In recent century, the use of concrete and steel has emerged in building method. Steel frame construction brings many advantages including lower costs, lower weight, higher speed, and the ease of construction. High strength, high rigidity, durability, low maintenance, and fire resistance are some benefits of concrete frame construction. Compound structures provide a possibility to utilize the advantages of both steel and concrete materials effectively. The present research is an attempt to consider the behavior of beam to-column connections of 174 samples including 100 samples and 74 samples of steels filled with concrete beam-to-column connections of steel in the finite- element analysis software ABAQUS. The effect of plate thickness to the beam connection steel columns filled with concrete on the seismic behavior of connections is also discussed. The results clearly show

the influence of the proposed strengthening method, a test program including 10 RC Beams with dimensions of$1700 \times 200 \times 200mm$ was planned. The beams were tested by two points loading at the midspan and a shear span of 600 mm on each side. The beams were fully shear reinforced at one side and poorly shear reinforced at the shear span on the other side(no shear reinforcement in 5 beams, 0S Beams, and only one middle stirrup in 5 beams, 1S Beams). The strengthening bolts were one No.10 steel bolt or two No.6 steel bolts, prestressed or non-prestressed. To simulate the actual load conditions, an initial load was applied before strengthening to make initial shear cracks. Strengthening was performed in two loading status, under constant load or after load removal. After strengthening, each specimen was loaded to failure and the load vs deflection at midspan was recorded and drawn. Failure mode for most of specimens was shear failure but it changed in two of specimens strengthened by prestressed steel bolts to bending failure. These two specimens also had the maximum ductility and energy dissipation.

Based on the results, embedding steel bolts effectively increased shear strength of beams in all test conditions, prestressed or non-prestressed bolts and constant load or load removal before strengthening, but better results were gained in prestressed bolts especially under constant load strengthening. Ductility and energy dissipation were also investigated. Prestressed bolts were considerably more effective in ductility and energy dissipation improvement.

Key Words: Shear strengthening, RC beams, prestressed bolt, embedded through-section.

WATER CONTENT EFFECT ON THE BEHAVIOR OF REINFORCED SOIL MIXTURE UNDER SURCHARGE LOAD WITH USING CENTRIFUGE

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Abstract

The most important problem in reinforced soil walls and slopes made from the mixture of soil grain and fine-grained is effect of moisture increase and additional pore water pressure onto the body of reinforced embankment. For this reason, in regulations, the maximum amount of fine-grained in materials of embankment is limited to 15%. In areas where suitable materials for embankment is not available, supply of remote areas is costly. Different regions of Iran soils with high percentage of fine-grained have large ranges in terms of regulation which are not suitable for construction reinforced soil walls and slops. In this study, additional attention has been paid to analysis of the effect of soil moisture content and existence surcharge load parameters in vertical reinforced soil walls and 20% fine-grained on potential slip surface and behavior of deformation wall using centrifuge.

In this study, a set of 6 centrifuge testes on soil walls reinforced with geotextile, which has fine-grained and moisture, was performed using the Geotechnical Research Center of Iran University of Science and Technology centrifuge, and the behavior of physical models in rotation using digital image processing technique was studied.

The results showed that by increasing moisture content, the amount settlements on the wall and deformation of wall facing increased, but changes in moisture content have not influence on location of failure surface. It was observed that in high moisture content, friction reduction between the soil and reinforcement leads to reducing reinforcements strain; as the result, reducing reinforcement performance by pull - out test in some cases.

It was also observed that reinforced layers placed in upper half of model and near strip footing experienced greater strains. The maximum strain of reinforcing layers always occurred in upper half of model. Also, a combination of image processing techniques all together with centrifuge tests creates a powerful and effective method in physical modeling of geotechnical phenomena, and very valuable results can be obtained from the images recorded during tests.

Key Words: Reinforced soil wall, moisture content, geotechnical centrifuge, image processing, geotextile.

EFFECT OF PRESTRESSING ON CONCRETE BRIDGE COLUMNS

ticular interests are lateral resistance and deformation which are considered in order to evaluate and compare different configurations of the 3D wall panels. It is necessary to mention that the stress-strain curve and other characteristic of shotcrete were employed for modeling in ABAQUS. So, some experimental tests were conducted on the cores of shotcrete for determining of mechanical properties of shotcrete used in the models. Also, some tension tests are conducted on steel wires used in the panels in order to evaluate the stress-strain curve of the steel. The results indicate that shotcrete behaves completely different from the concrete. Also, the results obtained from pushover analysis show that increase of the diameter of steel mesh bar, the ratio of height to length (H/L), and decreasing of the distance longitudinal bars cause to lateral load bearing enhancement. But, increase of the diameter of transverse bars, thickness of shotcrete layers, and decrease of the distance of transverse bars have no significant effects on the lateral bearing load.

Key Words: 3D Panel, shotcerete, light weight concrete, nonlinear static analysis, finite element studies.

EVALUATION OF THE CAPACITY SPECTRUM FOR STEEL STRUCTURE WITH STEEL SHEAR WALL WITH NONLINEAR STATIC ANALYSIS (PUSHOVER) AND ENERGY METHOD WITH NO CONTROL SPOT

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Abstract

In drawing the structure displacement capacity spectrum of a degree of freedom equivalent in increasing nonlinear static analyses to evaluate the structure performance, a point of a structure should be considered as a control point where it is usually considered as center of mass in building frames. In this article, displacement capacity spectrum has been calculated via two methods based on the energy without the need to determine control points, for 12 steel frames of 7, 15 and 30 classes in two dimension in two modes of 5 and 7 spans with joint and clamped connections under the effect of major mode and higher modes. They have been compared with displacement capacity spectrum of different classes. Evaluation of the results shows that the two methods based on the energy indicate the fact that the displacement capacity spectra are close to each other. and comparing them with displacement capacity spectrum with respect to roof point as control point shows that displacement capacity spectrum of roof point in the first mode on the displacement capacity spectrum obtained from the two methods of energy is consistent.

Key Words: Steel plate shear wall, acceleration displacement, capacity spectrum, increasingly nonlinear static analysis.

EXPERIMENTAL INVESTIGATION ON SHEAR STRENGTHENING OF RC BEAMS BY PRESTRESSED EMBEDDED THROUGH-SECTION BARS

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Abstract

In this paper, shear strengthening of RC beams with insufficient shear reinforcement by a new proposed technique, Prestressed Embedded Through-Section Bars (PETSB), was studied experimentally. This technique consist of boring holes through beam web and embedding steel bolt and tightening the bolt to the predetermined prestressing force. In order to investigate

SHRINKAGE OF CEMENT CONTAINING SLAG

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Abstract

Over the recent decades, understanding fundamental aspects of cement chemistry has advanced. Due to the recent developments in the field of cement for improving and reducing the negative environmental impacts of cement production, it is necessary to model or simulate hydration reactions of the cementitious materials. The process in which the cementitious materials form is of great importance. Hence, employing thermodynamic science properly is important. This knowledge gives a powerful insight into developing links between the mineralogy and engineering properties of hydrated cement paste and, therefore, anticipates improvements in its performance of cement production.

The hydration process is dramatically influenced by cement chemistry and microstructures, as a slight change in cementitious generic ingredients can create great differences in the hydration products. Usage of supplementary cementitious materials has considerable influence on the amount and kind of hydrates formed and thus volume, porosity and durability of cementitious systems. In this paper, blast furnace slag of Esfahan Steel Company with the replacement percentages of 10 to 80 was used to make several thermodynamical models at constant temperature of 20°C.

Thermodynamic modeling was based on the method of minimizing Gibbs free energy to calculate the composition of the pore solution and solid phase's developments. It is ideal for better understanding reactions' mechanisms during the hydration process. GEM software was applied for thermodynamical modelling. The formed phases assemblage, concentration of pore solution and chemical shrinkage of models were examined.

Thermodynamic calculations indicate that slag consumes portlandite and increases calcium silicate hydrates. It also reduces the pore solution volume that results in higher chemical shrinkage and increases the amount of hydrotalcite. Overall, the findings of slag replacement in cement are higher volume of hydrates, improvement of mechanical properties and, enhanced durability of concretes with cementitious materials.

Key Words: Thermodynamics, modeling, hydration, portland cement, slag.

A NUMERICAL STUDY ON LATERAL PERFORMANCE OF 3D SHOTCRETE WALL PANELS UNDER INCREMENTAL LATERAL LOAD

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Abstract

The use of 3D shotcreted panel is increasing in housing industry all over the world due to its unique advantages such as being light weight, fast construction, and easy to work with. 3D wall panels are the most common production of light weight precast shotcrete that are used as load bearing and nonstructural partition walls in structural building. There are many parameters affect structural behavior of 3D wall panels under different loading pattern that have not been considered yet though many researchers studied on this type of structural building system. In this research, structural behavior of light weight precast shotcreted wall is investigated using finite element method. Different parameters like distance and diameter of steel mesh bar, the ratio of height to length (H/L), the thickness of shotcrete, the shape of shotcrete layer and the direction of connectors are taken into account. Nonlinear static analysis (pushover) is performed using finite element ABAQUS software. Of par-

walls, which creates a coupling action resisting a portion of the total overturning moment induced by the base shear. This element has been usually made of deep reinforced concrete (RC) beam. In addition, Steel coupling beam in RC coupled shear wall system is a proper substitute for deep RC coupling beam. Coupling beam must behave in a ductile manner, yield before the wall piers, and exhibit significant energy dissipation characteristics. Therefore, coupling beams should be designed to avoid over coupling, which causes the system to act as a single wall. In addition, light coupling should be avoided as it causes the system to behave like two isolated walls. Therefore, it is obvious that for a precise understanding of the seismic behavior of tall buildings with coupled shear walls, their accurate nonlinear modeling is necessary. Most of the numerical modeling methods for coupling beams employ the FEM with fine meshes that are costly and time-consuming. In this paper, by introducing a new technique, accurate nonlinear dynamic modeling of the concrete shear wall with steel or concrete coupling beam is performed by employing bar elements. In this technique, coupling beams are modeled using an elastic beam, shear-flexural hinges, and shear and sliding hinge. In addition, shear walls are modeled by employing multi-layer shell finite elements with fiber sections where they can consider the confinement effect in wall's edges. In order to verify the proposed model of coupled shear walls, the results of numerical analyses are compared with those of experimental model. The results indicate that the technique proposed in this paper to model the dynamic behavior of these walls can adequate simulate their behavior.

Key Words: Concrete coupled shear wall, concrete coupled beam, steel coupled beam, numerical modeling, cyclic nonlinear analyses.

EVALUATING THE PERFORMANCE OF ZNO NANOPARTICLES ON THE CEMENT BASED MATERIALS ENGINEERING CHARACTERISTICS

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Abstract

Nowadays, due to the combustion of fossil fuels and widespread applications of chemical compounds in industries, huge amounts of pollutants are released into the environment. Thus, new technologies, such as nanotechnology, should be employed to solve this problem and degrade the pollutants. Investigations reveal that photocatalytic Oxidation- reduction reaction compared to conventional methods of removing contaminants is more efficient. The aforementioned reactions are activated easily by sunlight. It appears that the use of photocatalytic nano particles as a complementary to the composition of cement- based coatings could decompose a wide range of organic pollutants, which result from fossil fuel combustion and chemical compounds. In this paper, the zinc oxide nanoparticles with different cement replacement levels of 0.1, 0.25, 0.5, 0.75, 1and 2 were used to create cement based surfaces with photocatalytic properties in cement matrix. In order to investigate the photocatalytic properties and the factors affecting the performance in the solution media, the methylene blue solution was used at a concentration of 5 milligrams per liter. The absorption was measured by a spectrophotometer. The results indicate that with increasing the substitution level of nanoparticles in cement paste, the photocatalytic properties were improved and the time of decomposition of methylene blue became shorter. In order to evaluate the performance of ZnO nanoparticles in the mechanical properties and durability of mortars containing the nanoparticles (with percentages 0.1,0.25,0.5,0.75,1and 2), compressive strengths, Rapid Chloride Migration coefficients, permeable voids levels and capillary water absorption contents were measured. The investigation into the mechanical properties and durability of the mortars, containing the nanoparticles, shows that the mixture with 0.75% nanoparticles outperformed the other mixtures in compressive strength in 28days. By increasing the substitution level of nanoparticles, the discontinuity between capillary spaces was increased and lower pore volumes were obtained, leading to a significant enhancement in the resistance against diffusion of chloride ions into concrete.

Key Words: Cement- based materials, nano zinc oxide, photocatalytic, mechanical properties, durability.

THERMODYNAMICAL STUDY OF HYDRATION AND CHEMICAL

SEISMIC PERFORMANCE ASSESSMENT OF ISOLATED STEEL MOMENT FRAMES WITH LOSS APPROACH

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Abstract

Earthquakes pose inevitable damage and loss of life in structures. Seismic isolation has proven to be an effective method to reduce the seismic vibration and mitigate seismic losses and damage costs. The isolator drastically reduces the main frequency of the structure and subsequently lowers the acceleration of the floors. While this flexible layer protects the building from destruction, it undergoes a relatively large displacement demand. Isolated structures as well as fixed structures could suffer from inelastic deformation and serious damage under intense seismic ground motions. Performance-based seismic design (PBSD) is a concept that permits the design of buildings with reliable understanding of the risk of life, occupancy, and economic loss that may occur as a result of future earthquakes. Also, Seismic loss estimation method combines seismic hazard, structural response, damage fragility, and damage consequences of allowing quantification of seismic risk based on seismic performance of a building is expressed as the probable damage and resulting consequences of a building's response to earthquake shaking. Nonlinear 4-story archetypes of conventional special moment resisting frame and isolated intermediate moment resisting frame were compared with each other under Far-Field and Near-Field ground motions. Detailed three-dimensional (3D) numerical models of the structures were developed in OpenSees software and Performance Assessment Calculation Tool (PACT) was used for the loss estimation of archetypes. The decision variables in this study were defined as expected annualized repair cost or financial losses (EAL) and expected annualized fatalities (EAF). The analysis results showed that seismic isolation reduces collapse probability, EAL and EAF in superstructures significantly and can be cost effective in mitigating seismic risk. Seismic isolation reduces EAL by 72% and 67% under Far-Field and Near-Field ground motions, respectively. Furthermore the result of this study showing that the effectivity of isolation system decreases in Near-Field compared with Far-Field ground motions. The economic feasibility studies showed that if isolation system is used, pay-back period times are around 14 and 18 years under Far-Field and Near-Field ground motions, respectively. The benefit of loss estimation approach is an improved method to assess the effectiveness of isolation system in terms of loss estimation.

Key Words: Performance-based seismic design, loss estimation, performance assessment, seismic isolation, cost-benefit analysis.

A PROPOSED NUMERICAL MODEL FOR NONLINEAR CYCLIC ANALYSIS OF STEEL AND CONCRETE COUPLING BEAMS IN RC COUPLED SHEAR WALLS SYSTEM

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Abstract

Concrete coupled shear walls consist of two reinforced concrete (RC) shear walls that are connected by coupling beams over the height of the wall. Coupling beams provide a transfer of vertical forces between adjacent

such as open-channel flow. The relative submergence (the ratio of water depth to the bed roughness length characteristics) is an essential factor in open-channel rough bed flow. The turbulence macroscales are one of the most important characteristics of turbulent flow, which can be affected by relative submergence. In fact, turbulence macroscales in wall turbulence transport momentum and provide a means of producing turbulent kinetic energy. In the case of rough bed flows, where roughness elements protrusions disrupt homogeneity of near-wall flow characteristic, turbulence macroscales show a complex behavior not only in near wall region, but also in region far from the bed. These issues should be studied considering the importance of relative submergence. The present research is an experimental study that is focused on the role of relative submergence on the structures of turbulent macroscales. To this end, stream-wise and normal-wise components of velocities are measured with the aid of particle image velocimetry (PIV) method in a rectangular open-channel. During laboratory measurements, three distinctly different hydraulic scenarios, where the ratio of flow depth to roughness height (i.e., relative submergence) changes from 7.5 to 10.8 , are covered. Various methods and concepts common in turbulence studies, such as vorticity, two-point correlation, Galilean decomposition, are implemented to determine the role of relative submergence in turbulent macro scales.

These measurements show that the overall shape of instantaneous vortices and turbulent structures does not change with relative submergence. However, the length of turbulent macroscale increases with the relative submergence. Furthermore, it is found that the ratio between the length of turbulent macroscale obtained from stream-wise velocity and those obtained from normal-wise velocity increase with the relative submergence. This observation represents that the stream-wise extension of stream-wise velocity is higher in comparison to normal-wise velocity.

Key Words: Rough bed, open-channel, relative submergence, turbulence macro length scale, particle image velocimetry (PIV).

DECLUSTERING OF EARTHQUAKE CATALOG AND MODELING OF AFTERSHOCKS USING ETAS MODEL

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Abstract

Declustering of an earthquake catalog is the process of separating an earthquake catalog into foreshocks, main shocks, and aftershocks. Several declustering algorithms have been developed over the years. Up to now, because of the simplicity of the algorithms and the availability of the source codes, most users have applied either the algorithm of Gardner and Knopoff (1974) or Reasenberg (1985). In this article in addition to traditional methods. We use the stochastic declustering approach introduced by Zhuang et al (The Epidemic-Type Aftershock Sequence (ETAS) model). In this model each earthquake has a computable probability to be a background (spontaneous) event or triggered by a previous event. The basis of this model is to find a mathematical function that can describe the seismic sequences in a given area. We use the R package ETAS which is an R implementation (through a C port) of the original Fortran code and produced by Jalilian and Zhuang.

For this study, an earthquake catalog of Hormozgan province of Iran is extracted. We select the earthquake data for the period of 1964 - 2016 from the rectangular geographical region 26-29E and 53-59N. We take magnitude threshold ML =4.0, and consider shallow events down to the depth of 30 km. The data are extracted from the International Institute of Seismology and Earthquake Engineering (IIEES).

There are many differences between the catalogs declustered using a variety of methods, so a general conclusion is difficult. The results showed that the ETAS model estimates the number of independent earthquakes less than Reasenberg method. In these cases, results were close to each other: assuming 90 percent probability of Gardner and Knopoff method and 50 percent probability of Uhrhammer method.

Key Words: Earthquake catalog, declustering, windowing method, omori law, ETAS model.

pendent of plate thickness. Effect of unloading on viscoelastic response of thick plates was studied using the presented method. The results show that viscoelastic plates recover its original state when the time tends to infinity once the applied load was removed. The results show that HSDT predicts the plate deformation more than FSDT and classical plate theory for all of the time of loading and this difference increases by increasing in plate thickness.

Key Words: Viscoelastic thick plates, stress relaxation, unloading, third order shear deformation theory, finite strip method.

RHEOLOGICAL AND MECHANICAL PROPERTIES OF FIBER SELF-COMPACTING CONCRETE UNDER HIGH TEMPERATURE

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Abstract

Use of common fibers, in addition to increasing ductility, toughness, first point cracking, and ultimate strain, plays a major role in preventing shrinkage and thermal cracks. The role of temperature in fiber bridging and change of material structure has been investigated in previous studies. Use of waste materials in structural materials can decrease further pollution of ecosystem. On the other hand, increase in oil and polymer-based waste materials, caused some concern in the international community because of the adverse environmental impact of this material. For this reason, in this research, steel fiber (0.4, 0.5 and 0.6), Polypropylene fiber (0.03, 0.05 and 0.1), and recycled Polyethylene terephthalate (PET) fiber (0.2, 0.3 and 0.4) percent of the concrete mixture volume were used. The results of the rheological (V-funnel, T50, Slump and L-Box), mechanical properties (e.g., compressive, flexural, and splitting tensile strength) and Ultrasonic Pulse Velocity (UPV) Test of self-compacting concrete exposed to temperatures of 20, 200, 300, 400, and 600° showed that high contents of fibers did not satisfy some rheological and mechanical aspects of self-compacting concrete. Steel fibers increased the compressive, flexural, and splitting tensile strengths of concrete with maximum amount of 9.8% and two other fibers cause 15% decrease in strength of unheated specimens at most. Fiber reinforced specimens had an increase in resistance in the range of 8 to 21% by heating specimens to600° . The flexural strength of steel fiber reinforced specimens had an increase of maximum 30% for unheated ones. PET and P.P. fiber reinforced specimens had 9 to 20% increase in flexural strength. The presence of fibers increases the mechanical strength, toughness, and ductility of concrete and prevents loss of strength and spalling phenomenon at high temperatures, as well as having a fundamental role in the reduction of heat, microcracks, and retaining fundamental structure of concrete.

Key Words: Fiber, toughness, heat, spalling.

AN ESTIMATION OF RELATIVE SUBMERGENCE EFFECTS ON TURBULENCE MACRO-SCALE STRUCTURES IN A PLAIN CHANNEL WITH ROUGH BED

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Abstract

Previous studies clearly show the importance of surface roughness for natural and artificial boundary-layer flows,

Abstracts of Papers in English

TIME-DEPENDENT DEFORMATION OF VISCOELASTIC THICK PLATES BY A FULLY DISCRETIZED FINITE STRIP METHOD USING HIGHER ORDER SHEAR DEFORMATION THEORY

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Abstract

Time-dependent deformation and critical load of viscoelastic thick plates were evaluated in the present study. The ordinary finite strip method was used with trigonometric functions in longitudinal direction and polynomial functions in transverse direction. The stiffness and geometric matrices were calculated based on virtual work principle and the finite strip formulations were constructed. The material properties were considered to be linear viscoelastic in the form of Prony series. In addition, the time discretization method was used to evaluate the time integral appeared in viscoelastic formulation. Maximum deflection of viscoelastic plates during the time of loading was calculated and the effect of plate thickness was considered on viscoelastic behavior. The results show that deformation of viscoelastic materials increases by the lower rate as the time of loading increases. The maximum deflections of viscoelastic plate in the first time of loading were compared with those of elastic deformation of plate, and the accuracy of results was evaluated. The maximum deflections of plates were calculated by present method with various time steps to assess the integration error induced in viscoelastic integral. The results show that using small time step, the results obtained from discretization method converge to each other. In addition, the results show that deformation of viscoelastic materials increases by the lower rate as the time of loading increases. Also, the buckling factor of was increased by increasing the plate thickness, whilst it contracts with thin plates in which was inde-