Evaluation of mechanical properties of fiber reinforced recycled concrete: effect of size and amount of recycled aggregate, type and amount of fibers

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ABSTRACT

In this research, recycled concrete aggregates are used instead of natural aggregates in concrete and then the recycled concrete is reinforced by fibers. The aim of this study is to investigate the effect of size and also the amount of the recycled concrete aggregates on the mechanical properties of concrete and then investigating the effect of addition of polypropylene and steel fibers on improving the mechanical properties of concrete. The results showed that compressive strength of concrete decreased by increasing replacement ratio of recycled aggregates. Also, the replacement of fine aggregate at the level of 30 percent has not significant effect on the compressive strength of concrete and so this mix can be selected as the optimum recycled mix design. In addition, the use of the fiber improves considerably the tensile and flexural strength of the recycled concrete so that the steel fiber has more positive effects on the tensile and flexural strength in comparison to the polypropylene fiber. In addition, when the concrete reinforced by the fiber is broken, the concrete is not disrupted and the fiber has an important role to reduce the growth of cracks after break.

ARTICLE INFO

Received: 01/11/2016
Accepted: 22/05/2017

Keywords:
Recycled concrete
Recycled aggregate
Mechanical properties
Steel fiber
Polypropylene fiber

DOI: 10.22065/jsce.2017.44438

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Study of failure mechanism of double-lap joints of steel to FRP by bolt and resin

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ABSTRACT

In this study, the behavior of joints in two sides of steel coat which are screwed to the composite plate, and joints of two sides of compound steel coat (bolted and bonded) to the composite plate has been studied. In the standards, distance of mechanical bolts from the edges and the distance of mechanical bolts from each other have been discussed. Different distances in the range of the standards determined for the distance of screws from edges and screws from each other. In this paper, the screw joints and the combined joints with different terminal distances for screws from the edges are modeled and studied. The results showed the basic effects of the terminal distance of the screw from the connection edges on the resistance and mechanism of break of screw joints. In combined joints, the terminal distance of the screw had trivial effects in the resistance and mechanism of joint break. In addition, overlap length of the connection elements on increase of joint resistance analyzed and studied. To do so, a combined joint with configuration of two steel plates and one CFRP/GFRP composite plates which were joined by two screws and adhesive layers with different overlap were modeled. The results showed the direct relationship between increase of overlap length and increase in resistance of the joint. Finally, a design guide to be used in practice was proposed.

ARTICLE INFO

Received: 02/09/2016
Accepted: 05/01/2017

Keywords:
Bolted joints
Hybrid joints
Failure mechanism of joints
FRP laminates
The overlap length of joint elements

DOI: 10.22065/jsce.2017.44437

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Modeling impact damper in building frames using GAP element

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ABSTRACT

Main effective factor in impact dampers to control vibration is to create disruption in structural oscillation amplitude using small forces induced by auxiliary masses to reduce strong vibrations. So far, modeling of the impact damper has been conducted solely through MATLAB software. Naturally, the functional aspects of this software are limited in research and development aspects compared to the common programs such as SAP2000 and ETABS. In this paper, a Single Degree of Freedom System, SDOF, is first modeled under harmonic loading with maximum amplitude of 0.4g in SAP2000 program. Then, the results are compared with numerical model. In this way, the proposed model is validated and the SDOF system equipped with an impact damper is investigated under the Kobe and Northridge earthquake records using SAP2000 model. Based on obtained results, the system equipped with an impact damper under the Kobe and Northridge earthquakes for structures considered in this study would have better seismic performance in which maximum displacements are reduced 6% and 33% respectively. Finally, impact dampers are modeled in a 4-story building structure with concentric bracing leading to 12% reduction in story drifts.

ARTICLE INFO

Received: 07/11/2016
Accepted: 06/01/2017

Keywords:
Non-linear damper
Impact damper
Single degree of freedom system
SAP2000 program

DOI: 10.22065/jsce.2017.44359

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Response of steel box columns in fire conditions

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ABSTRACT

Effect of elevated temperatures on the mechanical properties of steel, brings the importance of investigating the effect of fire on the steel structures anxiously. Columns, as the main load-carrying part of a structure, can be highly vulnerable to the fire. In this study, the behavior of steel gravity columns with box cross section exposed to fire has been investigated. These kinds of columns are widely used in common steel structures design in Iran. In current study, the behavior of such columns in fire conditions is investigated through the finite element method. To perform this, the finite element model of a steel column which has been previously tested under fire condition, was prepared. Experimental loading and boundary conditions were considered in the model and was analyzed. Results were validated by experimental data and various specimens of gravity box columns were designed according to the Iran's steel buildings code, and modeled and analyzed using Abaqus software. The effect of width to thickness ratio of column plates, the load ratio and slenderness on the ultimate strength of the column was investigated, and the endurance time was estimated under ISO 834 standard fire curve. The results revealed that an increase in width to thickness ratio and load ratio leads to reduction of endurance time and the effect of width to thickness ratio on the ultimate strength of the column decreases with temperature increase.

ARTICLE INFO

Received: 29/10/2016
Accepted: 07/02/2017

Keywords:
Steel column
Local buckling
Critical temperature
Finite element method
Fire

DOI: 10.22065/jsce.2017.44333

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The structural response and behavior of progressive collapse in RC buildings under the blast and proposal for retrofitting columns against blast

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ABSTRACT

In accidents caused by explosion, the initial damage is usually caused by direct hit blast that it causes damage and serious destruction of structural components. In this state, the collapse of structural components and the subsequent progressive collapse may cause an increase in damages and eventually collapse of the structure. On the other hand, observations show that most of these buildings designed and built without consideration of their vulnerability to such events. In this study, global and local response of reinforced concrete buildings and their damages evaluated against explosion. First the global stability of building using SAP2000 is evaluated against explosion and then the amount and behaviour of damages in The key structural components of the building after the explosion is investigated using LS DYNA. The study involved four important areas in structural engineering that includes blast load determination, numerical modelling with FEM techniques, material performance under high strain rate and non-linear dynamic analysis. Two types of design methods are recommended for RC columns to provide superior residual capacities. They are RC columns detailing with additional steel reinforcement cages and a composite columns including a central structural steel core. The results showed that the use of this type of columns compared to typical RC column against explosion can have a significant impact in increasing the bearing capacity of structural components against gravity loads after the explosion.

ARTICLE INFO

Received: 15/08/2016
Accepted: 29/03/2017

Keywords:
Explosion
Progressive collapse
RC building
Non-linear dynamic analysis
Damage index

DOI: 10.22065/jsce.2017.77550.1076

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The effect of tectosilicates micronized additives on physical and mechanical properties improvements of Cob (Kahgel) plaster

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ABSTRACT

Kahgel (Cob) is one of the oldest traditional mortars in Iran. Kahgel plaster consists of high clay content, dried mud and a portion of straw fibers to defend the mortar against shrinkage cracks. The ancient waterproof covering is very efficient at protecting the building dry during the heavy rain showers, but low durability and the need for renewal of plaster due to erosion of rainfall suggest that Kahgel plaster is weak and unstable. So, it is very essential and necessary in finding appropriate scientific methods to enhance the durability and lifespan of Kahgel plaster. Studies on the stabilization and improvement of Kahgel plaster properties indicated that using some special tectosilicates additives can be improved significantly the physical and mechanical properties of earth and earthen materials such as Kahgel plaster. The effect of different micronized tectosilicates additives used to build the different samples of Kahgel plaster on physical and mechanical properties to enhance the durability of Kahgel plaster showed that Microsilica at 6% (by weight of Khahgel), reduced hydraulic conductivity of the Kahgel plaster at 33% level and micronized Zeolite at 3% (by weight of Khahgel), is increased by 85%. In addition, Microsilica and micronized Zeolite at 3% (by weight of Khahgel), increased compression strength of the Kahgel plaster at 73% and 36%, respectively. In addition, micronized Kaolin and Bentonite, increased uniaxial compression strength of the Kahgel plaster at 39 % and 33 %, respectively. In addition evaluation of water erosion of the samples during rainfall by rainfall simulator showed that use of Microsilica, Feldspar, Zeolite and Kaolin 3% (by weight of Khahgel), the minimum sample's total dry material loss of the Kahgel plaster reduced to 10/5% and the maximum decrease to 37/7% and increase durability of the Kahgel plaster against water erosion. Experimental results indicated that in addition to the type and percentage of additives, particle size plays an important role on the physical and mechanical properties of Kahgel plaster.

ARTICLE INFO

Received: 03/10/2016
Accepted: 30/12/2016

Keywords:
Earthen architecture
Kahgel
Micronized additives
Tectosilicates
Conservation

DOI: 10.22065/jsce.2017.43832

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Investigate effects of the core distance from confining concrete on behavior of buckling restrained braces

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ABSTRACT

Due to disadvantages of seismic behavior in conventional braces in term of low plasticity and asymmetric hysteresis curve in tension and compression and pinching which reduces the energy dissipation rate, Buckling Restrained Braces (BRBs) have been proposed as a new generation of bracing system. This paper examines specific type of these braces with steel core and concrete sheath. The effects of core distance from confining concrete of these braces haven been discussed using Finite element analysis method. The results show that buckling mode and energy absorption of this system have largely depend on the distance, and 2 to 4 mm distance causes the most energy dissipation.

ARTICLE INFO

Received: 03/04/2016
Accepted: 13/02/2017

Keywords:
Buckling Restrained Brace (BRB
Core distance from concrete
Hysteresis curve
Energy dissipation

DOI: 10.22065/jsce.2017.43234

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Effects of Calcined clay minerals and Silica fume on the compressive strength of concrete

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ABSTRACT

Pozzolanic materials are well known as potential replacements for cement manufacturing in order to increase compressive strength and improve durability of concrete in different environments and leading to save energy particularly reducing global warming effect. The present study reveals the effect of calcined clay minerals as natural pozzolanic material, separately and in combination with and without silica fume. To achieve this aim, 15 mixed designs with a constant water to cementitious ratio of 0.38 is made. In six mixed designs only metakaolin, zeolite or silica fume and in eight other designs metakaolin and silica fume or zeolite and silica fume have been combined. Mixes containing metakaolin or zeolite with ratio of 10 or 20 percent and silica fume with 7 or 10 percent show significant increasing in compressive strength and improving durability, being valuable replacement for cement (in percentages). In particular, the best practice is attributed to the age of 28 days for compressive strength the replacement of the composition is 10% zeolite with 7% of silica fume and for electrical resistance the replacement of the composition is 10% zeolite with 7% of silica fume.

ARTICLE INFO

Received: 31/08/2016
Accepted: 13/02/2017

Keywords:
Concrete
Calcined clays
Silica fume
Compressive strength

DOI: 10.22065/jsce.2017.43232

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A robust finite element model updating method for pier's structure with uncertainties in connections using particle swarm optimization algorithm

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ABSTRACT

Conventional design of piers is done by assuming fully rigid connection of deck to piles. In practice, these connections are semi-rigid. Semi-rigid connections cause changes in the dynamic characteristics of the structure such as natural frequencies and mode shapes. In this study experimental modal analysis performed on model of a pier structure. Numerical model performed in ANSYS and MATLAB software. Determination of percentage of semi-rigid connections considered as optimization problem based on numerical and experimental frequencies. Problem solved by particle swarm optimization algorithm. By solving problem, percentage of rigid connection identified. For updating finite element model, linear elastic rotational springs employed instead of connections in theoretical model.

ARTICLE INFO

Received: 22/08/2016
Accepted: 05/02/2017

Keywords:
Modal Analysis
Pier
Particle swarm optimization
Semi-rigid connections
Finite element model

DOI: 10.22065/jsce.2017.42928

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Reliability-based topology optimization of bridge structures using first and second order reliability methods

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ABSTRACT

Reliability-based topology optimization (RBTO) results in an optimal topology satisfying given constraints with consideration of uncertainties in the variables. Due to inherent uncertainties, including external loading, material properties, and the quality of construction, prototypes and products may not satisfy the essential functions required. In RBTO, each of these uncertain parameters are treated as random variables and reliability constraints are used in the formulation of the topology optimization problem to obtain a more reliable structure. In this article, RBTO was applied to obtain reliable topologies for two bridge structures using the Solid Isotropic Microstructure with Penalization (SIMP). The first and second order reliability methods are used as reliability analysis methods to take into account the uncertainties of the load, Young's modulus and thickness. It was found that in optimal topologies obtained by RBTO, the corresponding compliance values are higher than values obtained by deterministic topology optimization (DTO) and increase the number of uncertain parameters which results in softer structures with higher compliances.

ARTICLE INFO

Received: 27/02/2016
Accepted: 25/11/2016

Keywords:
Topology optimization
Reliability analysis
Second order reliability method
SIMP
RBTO

DOI: 10.22065/jsce.2016.40432

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