Experimental and numerical study of FRP encased composite columns

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ABSTRACT

A new type of composite column is presented and assessed through experimental testing and numerical modeling. The objective of this research is to investigate design options for a composite column without the use of ferrous materials. This is to avoid the current problem of deterioration of concrete due to expansion of rusting reinforcement members. Such a target can be achieved by replacing the steel reinforcement of concrete columns with pultruded I-shape glass FRP structural sections. The composite column utilizes a glass FRP tube that surrounds a pultruded I-section glass FRP, which is subsequently filled with concrete. The GFRP tube acts as a stay-in-place form in addition to providing confinement to the concrete. A total of four composite columns were tested under monotonic axial loading. The experimental ultimate capacity of each of the tested composite column was compared to the predicted numerical capacity using ANSYS program. The comparison showed that the predicted numerical values were in good agreement with the experimental ones.

ARTICLE INFO

Received: 01/09/2016
Accepted: 26/12/2016

Keywords:
Composite column
Concrete
FRP
Confinement,
Tube
Pultruded
Compression

DOI: 10.22065/jsce.2016.41235
http://dx.doi.org/10.22065/jsce.2016.41235

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Evaluation of using triangular plates as continuity plates in box column section in prequalified welded connections under cyclic loading

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ABSTRACT

Welding of Continuity plates in box columns are not easily possible, therefore some researches has been done for substitution of external continuity plates. In this study first effects of continuity plate in I beam to Box column with top and bottom plate (WFP) and welded unreinforced flange-welded web connection (WUF-W) and reduced beam section connection (RBS) was discussed. Then, usage of triangular plates in connection of beam to box column as continuity plates under cyclic loading was studied. Studies have shown that existence of continuity plates in connections mentioned above have averagely increased loading capacity, rigidity and energy absorption 63, 86 and 75 percent respectively. The results also showed that using of triangular plates as continuity plates of box columns causing plastic strain in column flange in the area that concentration of materials is not much in triangular plates and increased the probability of failure in weld of plates to the column flange. Also using of triangular plates as continuity plates have not affected plastic hinge location.

ARTICLE INFO

Received: 01/11/2016
Accepted: 26/12/2016

Keywords:
Steel structures
Continuity plates
Moment connections
Reduced beam section
Triangular plates

DOI: 10.22065/jsce.2016.41236
http://dx.doi.org/10.22065/jsce.2016.41236

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Comparison of the efficiency of tuned mass and tuned liquid dampers at high-rise structures under near and far fault earthquakes

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ABSTRACT

Tuned mass and tuned liquid dampers are most common passive control systems that used for decrease of seismic responses of buildings. In this study, the performance of high-rise buildings with TM and TL dampers are evaluated under seven near-fault and seven far-fault earthquakes. For this purpose, a twenty-four stories steel moment frame building has been considered and the time history dynamic analyses are performed for both of controlled and uncontrolled states. Moreover, this building has been also modelled with five various mass, stiffness and damping ratios. The results have been shown that decreasing the structural responses at tall buildings against near-fault earthquakes are more than far-fault earthquakes due to the effect of higher modes. Furthermore, the tuned mass damper has better performance at decreasing of the responses in comparison of tuned liquid dampers.

ARTICLE INFO

Received: 21/05/2016
Accepted: 26/12/2016

Keywords:
Tuned mass damper
Tuned liquid damper
Near-fault earthquake
Far-fault earthquake
Tall building

DOI: 10.22065/jsce.2016.41242
http://dx.doi.org/10.22065/jsce.2016.41242

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Numerical investigation of soil and buried structures using finite element analysis

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ABSTRACT

Today the important of studying soil effect on behavior of soil contacted structures such as foundations, piles, retaining wall and other similar structures is so much that neglecting of soil-structure interaction effect can cause to untrue results. In this paper soil-structure interaction simulation was done by using Finite element method analysis with ABAQUS version 6.13-14. The results have been presented based on pile function in contact with soil, vertical stresses in soil and structures, pore pressure in drained and undrained condition and underground water level. Final conclusions revealed that pore pressure effect is not uniform on all parts of pile and amount of pore pressure increment in top elements is lower than down elements of pile. Finally, it was concluded that 70% of pile bearing capacity is depend on friction of soil and pile contact surface.

ARTICLE INFO

Received: 08/05/2016
Accepted: 26/12/2016

Keywords:
Soil and structures interaction
Finite element analysis
Pile bearing capacity
Underground water level
Pore water pressure

DOI: 10.22065/jsce.2016.41241
http://dx.doi.org/10.22065/jsce.2016.41241

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Damage detection of reinforced concrete shear walls using mathematical transformations

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ABSTRACT

Structural health monitoring is a procedure to provide accurate and immediate information on the condition and efficiency of structures. There is variety of damage factors and the unpredictability of future damage which is a necessity for the use of structural health monitoring. Structural health monitoring and damage detection in early stages is one of the most interesting topics that had been paid attention because the majority of damages can be repaired and reformed by initial evaluation, thus the spread of damage to the structures, building collapse and rising of costs can be avoided. Detection of concrete shear wall damages that are designed to withstand the lateral load on the structure is critical. Because failures and malfunctions of shear walls their failure can lead to serious damage or even progressive dilapidation of concrete structures. Change in stiffness and frequency can clearly show the damage occurrence. Mathematical transformation is also a tool to detect damage. In this article, with non-linear time history analysis, the finite element model of structures with concrete shear walls subject to four earthquakes have extracted and using Fourier and wavelet transform the presence of shear walls is detected at the time of damage.

ARTICLE INFO

Received: 08/10/2016
Accepted: 26/12/2016

Keywords:
Structural health monitoring
Damage detection
Reinforced concrete shear wall
Mathematical transformation

DOI: 10.22065/jsce.2016.41239
http://dx.doi.org/10.22065/jsce.2016.41239

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Innovative constructional detail of moment resisting connection joined to cruciform columns

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ABSTRACT

The rate of applying cruciform columns with bolted connection in double-directed moment resisting frames and tubular systems has positive trend because of their architectural advantages. Construction of double plate for shear strengthening panel zone and continuity plate, with regard to special moment resisting frame requirement, needs convenient detail which is presented in this research. There was no applicable information in this research field, so new constructional details involving inclined plates and vertical angles were presented in order to strengthen the panel zone. Furthermore, the different welding configurations were studied. For this reason, 16 nonlinear numerical models were simulated to study different constructional detail of panel zone. In present research, steel material and weld behavior were evaluated by fracture indexes of material. Results show the performance of panel zone will be improved by using proposed constructional details.

ARTICLE INFO

Received: 07/08/2016
Accepted: 26/12/2016

Keywords:
Rupture index
Welded connection
Cruciform column
Panel zone
Seismic performance

DOI: 10.22065/jsce.2016.41238
http://dx.doi.org/10.22065/jsce.2016.41238

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Evaluation of safety Index and calibration of load and resistance factors for reinforced concrete beams under bending, shear and torsion demands

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ABSTRACT

The aim of designing structural members is to withstand against different loading conditions such that the safety of the system could be preserved. The conventional method for designing of reinforced concrete members in Iranian concrete code is based on load and resistance factor. Although, load and resistance parameters are random variables, and in the mentioned Code the constant values have been designated for them during the designing procedure accounting these factors as the constants parameters will ultimately be led to the unsafe and uneconomical designs. The main purpose of this paper is probability-based designing of reinforcement concrete beams under simultaneous effects of bending, shear and torsion actions. For this purpose, analytical relations of the limit states for combination of bending, shear and torsion have been developed. Using this method, the structural designers could be fulfilled the designing of the RC beams based on the importance of structures and the required safety indexes of the owners. The next goal of this investigation is evaluation and calibration of load and resistance factors for desired safety index. The economic and fully probabilistic designing of concrete beams for simultaneous effects of bending, shear and torsion are available by implementing the proposed design procedures. In order to calculate the safety indexes a computer program has been written in the MATLAB environment and the Monte Carlo simulation technique has been utilized.

ARTICLE INFO

Received: 05/04/2016
Accepted: 22/11/2016

Keywords:
Limit state function
Reliability-based design
Safety Index
Load and resistance factors
Monte-Carlo simulation

DOI: 10.22065/jsce.2016.4123
http://dx.doi.org/10.22065/jsce.2016.41237

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Performance evaluation of moment connections of moment resisting frames against progressive collapse

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ABSTRACT

When a primary structural element fails due to sudden load such as explosion, the building undergoes progressive collapse. The method for design of moment connections during progressive collapse is different to seismic design of moment connections. Because in this case, the axial force on the connections makes it behave differently. The purpose of this paper is to evaluate the performance of a variety of moment connections in preventing progressive collapse in steel moment frames. To achieve this goal, three prequalified moment connections (BSEEP, BFP and WUP-W) were designed according to seismic codes. These moment connections were analysed numerically using ABAQUS software for progressive collapse. The results show that the BFP connection (bolted flange plate) has capacity much more than other connections because of the use of plates at the junction of beam-column.

ARTICLE INFO

Received: 19/06/2016
Accepted: 20/11/2016

Keywords:
Progressive collapse
Numerical analysis
Prequalified moment connections
Steel structures

DOI: 10.22065/jsce.2016.40426
http://dx.doi.org/10.22065/jsce.2016.40426

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Nonlinear modeling of unreinforced masonry wall under in-plane load and investigation of the effect of various parameters

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ABSTRACT

In this article, an unreinforced masonry wall under in-plane load was numerically modeled using the ABAQUS software. In order to model the material of masonry, concrete material in the material library of ABAQUS software was used. The concrete damaged plasticity method in the ABAQUS software is a model that was meticulously studied in this research. Initially the governing factors influencing the behavior of this model were introduced, and then the cases provided for this purpose were separately investigated. To this end, an unreinforced masonry wall (100 × 990 × 1000 mm) which has been placed under the in-plane load in the lab, and its laboratory results are available was modeled in the ABAQUS software and after defining the required specifications, the effect of various parameters such as stress cracking, dilation angle, strain cracking, viscosity, and etc. was investigated. For modeling the wall, macro method, which is one of the modeling methods of masonry materials was used. After calibration of the numerical model with the laboratory results, the effect of all of the available parameters in the concrete damaged plasticity model was investigated, and their effect was shown in the load-displacement diagram as well as the contour stress. A meticulous parametric investigation would give a better understanding of the way of functioning of these parameters in the modeling. In addition, it offers a better understanding for the users to use appropriate parameters in the modeling.

ARTICLE INFO

Received: 12/04/2016
Accepted: 15/11/2016

Keywords:
Masonry wall
Numerical modeling
Finite element
Nonlinear behavior
Concrete damaged plasticity

DOI: 10.22065/jsce.2016.39572
http://dx.doi.org/10.22065/jsce.2016.39572

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An investigation on vulnerability assessment of steel structures with thin steel shear wall through development of fragility curves

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ABSTRACT

Fragility curves play an important role in damage assessment of buildings. Probability of damage induction to the structure against seismic events can be investigated upon generation of afore mentioned curves. In current research 360 time history analyses have been carried out on structures of 3, 10 and 20 story height and subsequently fragility curves have been adopted. The curves are developed based on two indices of inter story drifts and equivalent strip axial strains of the shear wall. Time history analysis is carried out in Perform 3d considering 10 far field seismograms and 10 near fields. Analysis of low height structures revealed that they are more vulnerable in accelerations lower than 0.8g in near field earthquakes because of higher mode effects. Upon the generated fragility curves it was observed that middle and high structures have more acceptable performance and lower damage levels compared to low height structures in both near and far field seismic hazards.

ARTICLE INFO

Received: 29/02/2016
Accepted: 10/08/2016

Keywords:
IDA curves
Fragility curves
Steel shear wall
Time history analysis

DOI: 10.22065/jsce.2016.38894
http://dx.doi.org/10.22065/jsce.2016.38894

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