EFFECT OF AXIAL STIFFNESS OF FRP BARS LONGITUDINAL REINFORCEMENT ON THE SHEAR CAPACITY OF RC BEAMS; FEM ANALYSIS

MOHAMED A.EL-KADER AHMED, MOHAMED F.M. FAHMY, OMAR A.FARGHL AND A.EL-RAHMAN MEGAHD AHMED

Abstract:

Use of FRP re-bars has increased rabidly since the last decade to avoid the deterioration of concrete structures caused by corrosion of steel reinforcement. Since FRP bars made from high tensile strength fibers such as carbon, glass, aramid and basalt embedded in polymeric matrices, they are anti-corrosion materials. However, the mechanical properties for FRP are different from steel bars; some types of FRP bars have a low relatively modulus of elasticity in comparison with conventional steel bars. Therefore shear capacity of RC beams reinforced with FRP bars could be different than those reinforced with steel bars, in this study a parametric analysis based on the finite element simulation was devoted to evaluate the effect of the axial stiffness of the reinforcement when FRP bars are used on the shear strength of RC beams. The analysis program consisted of two series of beams with concrete compressive strength 13 MPa and 33.5 MPa with six values for the elastic modulus of the reinforcement 35, 51.5, 100, 150, 209 and 300 GPa with reinforcement ratio 0.91% and shear span to depth ratio 3.0, It was found that the reinforcement axial stiffness significantly influences the depth of compression zone and the shear strength of beams as well as the service load.

Keywords:

Shear failure, Service load, FRP re-bars, Finite element analysis

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International Conference on Advances in Structural and Geotechnical Engineering (ICASGE’15) , ,
Bond-Based Earthquake-Proof of RC Bridge Columns Reinforced with Steel Rebars and SFCBs

Mohamed F.M. Fahmy1 and Zhishen Wu2

Abstract:

Bond between reinforcement and the adjoining concrete has been extensively studied, and it is confirmed that the use of deformed bars is essential for composite behavior of reinforced concrete (RC) structures. But since bond between the longitudinal bars and concrete results in concentration of damage at a specific localized interval of longitudinal bars where the local buckling occurs, Takiguchi et al. (1976) suggested mitigating this concentration of damage through unbonding of the longitudinal bars from concrete at plastic hinge zone. Kawashima et al. (2001) conducted an experimental study on RC columns reinforced with different lengths of unbonded bars at the plastic hinge zone. It was noticed that the failure of concrete was much less in the unbonded column than standard column, and strain on unbonded bar was less than that on the reinforcement of standard column. Recently, to improve the seismic performance of RC members, it is highlighted in the study of Pandey and Mutsuyoshi (2005) that reducing bond strength between the longitudinal bars and concrete has a favored effect on the failure mode, shear capacity and ductility of RC bridge piers: failure mode at ultimate state is changed from shear to flexural and shear strength and ductility are increased. In the performance-based design approach, the design is primarily focused on meeting a performance objective, which is in line with a desired level of service (Floren et al., 2001, Priestley et al., 2007). For instance, new seismic design philosophies for bridges recommend that important bridges subject to massive earthquakes should be able to sustain the expected maximum lateral force in the inelastic stage with limited damages. To achieve this aim, structure should realize the existence of post-yield stiffness, damage level should be limited, and its permanent deformations (residual deformations) should be smaller than a specified limit; and all these indices are essentially dependent on the composite behavior of RC structures. On the other hand, the studies of Kawashima et al. (2001) & Pandey and Mutsuyoshi (2005) revealed the importance of reducing concrete-to-steel bond to mitigate the concentrated damage in the plastic hinge zone. In the last two decades, civil engineers and designers have attempted to develop and adopt new forms of materials that would assist in the building of stronger, larger, more longer

Published In:

Intechopen , pp. 429 - 454
Mitigation of residual deformations of RC bridge piers using steel fiber composite bars as longitudinal reinforcement

Fahmy, M.F.M., Wu, Z.S., and Wu, G

Abstract:

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Keywords:

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Published In:

CD-ROM, Joint Conference (7th International Conference on Urban Earthquake Engineering (7CUEE) & 5th International Conference on Earthquake Engineering (5ICEE)), March 3-5, 2010, Tokyo Institute of Technology, Tokyo, Japan. , NULL , NULL
Effect of bond parameters on recoverability of RC bridge columns reinforced with ordinary rebars and steel fiber composite bars,

Fahmy, M.F.M. Wu, Z.S. and Wu, G

Abstract:

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Keywords:

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Published In:

CD-ROM 5th International Conference on FRP Composites in Civil Engineering (CICE2010) Beijing, China, NULL, NULL
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Safety enhancement of urban structures with structural recoverability and controllability

Wu, Z.S., Fahmy, M.F.M., and Wu, G

Abstract:

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Keywords:

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Published In:

Journal of Earthquake and Tsunami, Vol.3 - No. 3, pp.143-174
Stress-strain relationship of circular columns confined with different FRP composites

Fahmy, M.F.M and Wu, Z.S

Abstract:

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Keywords:

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Published In:

Journal of Applied Mechanics, (JSCE) , Vol. 12 , pp. 945-956
Damage-controllable structure systems using FRP composites

Wu, Z.S., Fahmy, M.F.M., and Wu G.

Abstract:

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Keywords:

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Published In:

Journal of Earthquake and Tsunami, Vol. 5 - No. 3, pp. 241-258
-Safety-enhancement of RC bridge frame columns using bond based damage-controllable steel basalt-fiber composite bars

Fahmy, M.F.M., Wu, Z.S., and Wu, G.

Abstract:

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Keywords:

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Published In:

Special Publication of American Concrete Institute (ACI, SP-275-26), NULL, NULL
Post-yield stiffnesses and residual deformations of RC bridge columns reinforced with ordinary rebars and steel fiber composite bars.


Abstract:

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Keywords:

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Published In:

Evaluating and proposing models of circular columns confined with different FRP composites

Fahmy, M.F.M. and Wu, Z.S.

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Keywords:

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Published In:

Post-earthquake recoverability of existing RC bridge piers retrofitted with FRP composites

Fahmy, M.F.M., Wu, Z.S., and Wu, G.,

Abstract:

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Keywords:

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Published In:

Construction and Building Materials, Vol. 24 - No. 6, pp. 980 - 998
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Fahmy, M.F.M. and Wu, Z.S

Abstract:

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Keywords:

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Published In:

CD-ROM, 9th International Symposium on Fiber Reinforced Polymer Reinforcement for Concrete Structures (FRPRCS-9), Sydney, Australia, NULL, NULL
Evaluation of models and proposing a new model of circular columns confined with different FRP composites.

Fahmy, M.F.M. and Wu, Z.S.

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Keywords:

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Published In:

Inter. Symp. on Innovation and Sustainability of Structures in Civil Engineering-ISISS, Guangzhou, China , NULL , NULL
Post-yield stiffness and residual deformation as seismic performance indices of FRP-RC bridge piers

Fahmy, M.F.M. and Wu, Z.S.

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Keywords:

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Proceedings of the Eleventh International Summer Symposium, 11 September 2009, Tokyo Institute of Technology, Tokyo, Japan. , NULL , NULL
Recoverability of FRP retrofitted columns with lap splice and plastic hinge deficiency

Fahmy, M.F.M. and Wu, Z.S

Abstract:

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Keywords:

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Published In:

CD-ROM, 4th International Conference on FRP Composites in Civil Engineering (CICE2008), Zurich, Switzerland
Second stiffness of FRP retrofitted bridge columns with shear deficiency

Fahmy, M.F.M. and Wu, Z.S.

Abstract:

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Keywords:

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Published In:

Proc., International Symposium on Innovation & Sustainability of Structures in Civil Engineering-ISISS, Shanghai, China, NULL, pp. 864-872
Experimental study for statical behavior of concrete-filled steel columns having different cross-section shapes

Megahed, A., Abdelhafez, A., Abdelkhalek, M.F., and Fahmy, M.F.M

Abstract:

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Keywords:

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Published In:

Proceeding of 1st International Conference of Civil Engineering Sciences, ICCES1, Assiut, Egypt, Vol. 1, pp. 612-623
Some parameters affecting shear behavior of high strength fiber reinforced concrete beams longitudinally reinforced with BFRP rebars

Awadallah, Z. H., Ahmed, M. M., Farghal, O. A., Fahmy, M. F. M.

Abstract:

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Keywords:

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Published In:

Experimental Study on Cyclic Response of Concrete Bridge Columns Reinforced by Steel and Basalt FRP Reinforcements.


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Keywords:

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Published In:

J. of Composites for Construction, NULL, NULL
Numerical Simulation on Fracturing Bond Mechanisms of Different Basalt FRP Bars. 71(2),

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Keywords:

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Published In:

Journal of Applied Mechanics (土木学会論文集 A2 (応用力学)), JSCE (Japan), Vol. 71 - No. 2, pp. 289 - 298
Exploratory Study of Seismic Response of Deficient Lap-Splice Columns Retrofitted with Near Surface-Mounted Basalt FRP Bars.

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Keywords:

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Published In:

J. Struct. Eng., NULL, NULL
3D finite element modeling of bond-controlled behavior of steel and basalt FRP-reinforced concrete square bridge columns under lateral loading.

Ibrahim, A. M., Fahmy, M. F. M., & Wu, Z.S.

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Keywords:

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Published In:

Composite Structures, Vol. 143, pp. 33-52

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Keywords:

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Published In:

Effect of using well-Confined Short Lap-Splice Reinforcement on Seismic Performance of Exterior Beam-Column Joint.

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Published In:

J. of Reinforced Plastic and Composites. Journal of Engineering Sciences, Assiut University, Faculty of Engineering, , Vol. 44 - No. 5 , NULL
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Keywords:

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Published In:

J. of Composites for Construction, NULL, NULL
Bond Slip Performance-Based Model for NSM Reinforcement in Concrete Elements..

Fathi, M. A., Fahmy, M. F.M., and Mahmoud, M. A.

Abstract:

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Keywords:

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Published In:

The Eighth Alexandria International Conference on Structural and Geotechnical Engineering (AICSGE8), Alexandria, Egypt. NULL. NULL
Shear Behavior Of Concrete Beams Reinforced With A New Class Of Composites Based On Using BFRP Rebars.

Awadallah, Z. H., Fahmy, M. F.M., Farghl, O. A. and Mahmoud, M. A.

Abstract:

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Keywords:

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Published In:

The Eighth Alexandria International Conference on Structural and Geotechnical Engineering (AICSGE8), Alexandria, Egypt.

NULL, NULL
Effect of Axial Stiffness of FRP Bars Longitudinal Reinforcement on the Shear Capacity of RC Beams; FEM Analysis.

Ahmed, M.A.A., Fahmy, M.F.M., Farghal, O., and Megahd, A.

Abstract:

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Keywords:

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Published In:

International Conference on Advances in Structural and Geotechnical Engineering ICASGE, NULL, NULL
Behavior of Reinforced High-Strength Concrete Short Columns Subjected to High Temperature.

Hassanean, Y.A., Diab, H. M.A., Fahmy, M.F.M., and Ismail, M.M.A.,

Abstract:

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Keywords:

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Published In:

International Conference on Advances In Structural And Geotechnical Engineering (ICASGE'15) , NULL , NULL
-Steel-CFRP Composite Bars as Shear Reinforcement for RC T Beams.

Fahmy, M. F.M. and Ibrahim, Z.

Abstract:

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Keywords:

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Published In:

18th International Conference on Composite Structures, , NULL , NULL
Restoration of Pre-damaged RC Bridge Columns with Deficient Plastic Hinge Regions Using Basalt FRP.

Fahmy, M. F.M. and Wu, Z.

Abstract:
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Keywords:
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Published In:
World Congress on Advances in Structural Engineering and Mechanics Songdo, Convensia Incheon, South Korea; NULL, NULL, NULL
Application of Different Stress-Strain Models of FRP-Confined Concrete in Numerical Evaluation of Ductility of FRP-Jacketed Circular Columns.

Essa, A.A.A., Fahmy, M.F.M., Farghal, O., and Megahd, A

Abstract:

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Keywords:

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Published In:

14th International Conference on Structural & Geotechnical Engineering; Cairo, Egypt, NULL, NULL
Damage-Controllable Basalt FRP Steel Reinforced Concrete Structural System.

Ibrahim, A. M. A., Fahmy, M. F.M., and Wu, Z.

Abstract:

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Keywords:

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Published In:

The 12th International Symposium on Fiber Reinforced Polymers for Reinforced Concrete Structures (FRPRCS-12) & The 5th Asia-Pacific Conference on Fiber Reinforced Polymers in Structures (APFIS-2015) Joint ConferenceNanjing, China.
-Comparative Study among FRP-Confined Concrete Stress Strain Models for Simulating Cyclic Response of Circular RC Columns.

Ismail, A. M., Fahmy, M. F.M., and Wu, Z.

Abstract:

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Keywords:

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Published In:

The 12th International Symposium on Fiber Reinforced Polymers for Reinforced Concrete Structures (FRPRCS-12) & The 5th Asia-Pacific Conference on Fiber Reinforced Polymers in Structures (APFIS-2015) Joint Conference, Nanjing, China.
General Review on Damage Controllability and Resilience of Structures with FRP Composites.

Wu, Z. and Fahmy, M. F.M.

Abstract:

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Keywords:

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Published In:

The 1st International Workshop on Resilience, Torino, Italy. , NULL , NULL
Simulating the lateral performance of FRP-confined RC circular columns using a new eccentric-based stress-strain model

Ahmed M. Ismaila, Mohamed F. Fahmyab, Zhishen Wu

Abstract:

In this study, a stress-strain model of fiber-reinforced polymers (FRPs)-confined concrete based on the lateral confinement stiffness was adopted to simulate the lateral response of RC columns retrofitted with external FRP jackets and tested under axial and lateral loads. The adopted model and other five-stress-strain models (established in former studies) were comparatively studied to simulate the seismic response of eight RC-circular columns retrofitted with FRP jackets and experimentally tested under both axial and lateral loads. Compared to the experimental results, the simulation results indicated that all stress-strain models could not identify properly the ultimate lateral displacements of the simulated columns. The adopted stress-strain model was revised to consider the effect of a key influential parameter (eccentricity ratio), which showed a critical impact on the simulation of the seismic response of RC-columns under combined bending and axial loadings. Finally, the proposed model was evaluated in predicting the lateral response of additional three columns and the simulation results exhibited a good agreement with the experimental results.

Keywords:

Eccentricity, Design-oriented model, Lateral loading, Circular column, FRP-jacket, OpenSees

Published In:

Composite Structures, Vol. 180, pp. 88-104
Experimental and Numerical Evaluation of the Shear Behavior of Reinforced Concrete T-Beams with Hybrid Steel-FRP Stirrups

Mohamed F. M. Fahmy; Zainab E. Abd-ElShafy; and Zhishen Wu

Abstract:

This study presents the shear behavior of reinforced concrete (RC) T-beams with innovative steel stirrups hybridized in the longitudinal direction with a fiber-reinforced polymer (FRP) composite. Six beams were experimentally tested: three beams were reinforced with the hybrid steel-FRP stirrups, and the others served as control samples and were reinforced with conventional steel stirrups. Furthermore, a two-dimensional finite-element (FE) model was created and executed using FE analysis software to examine the effect of several influential parameters, including the type and amount of FRP used in producing the hybrid stirrups. Large-scale beams reinforced with carbon FRP (CFRP) stirrups were numerically simulated before and after replacing the transverse CFRP reinforcement with steel-FRP stirrups. Compared with conventional RC beams, concrete beams reinforced with steel-FRP stirrups successfully showed a considerable increase in the beam shear strength and deformability. Moreover, hybrid steel-FRP stirrups can provide design engineers with a new, flexible design to control both the structural response and the construction cost.

Keywords:

NULL

Published In:

Journal of Composites for Construction, NULL
Behavior of Reinforced High-Strength Concrete Short Columns Subjected to High Temperature

Yehia A. Hassanean1, Hesham M. Diab, Mohamed F.M. Fahmy, Mustafa M.A. Ismail

Abstract:

The increasing use of high-strength concrete (HSC) for structures has been widely noticed in recent years. The risk of exposing these HSC structures to high-temperatures during a fire has increased significantly in Egypt. Consequently, the safety of such structures during and after a fire is important which depends on the mechanical properties of HSC structure elements subjected to high-temperature. The main objective of this study is to investigate the residual mechanical properties of high-strength concrete short columns with regard to high-temperature effects. This study presents the results of twenty-nine high-strength short columns 100×100×400 mm exposed to high-temperature cycle and tested under static loading up to failure. Different parameters were considered during this study such as percentage of longitudinal reinforcement, thickness of concrete cover, and temperature degree level. Experimental results showed that the compressive strength of high strength concrete has a little change until 400°C; however, beyond this degree of temperature a 55% reduction in the compressive strength was noticed compared with specimens at room temperature. Also, cooling of heated samples in water decreased the residual strength by 36% compared with their counterparts cooling in air.

Keywords:

Keywords: High-strength concrete, High temperature, Residual strength, Reinforced concrete columns.

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International Conference on Advances in Structural and Geotechnical Engineering, NULL, NULL
Behavior of the Concrete Core at the Critical Zones of Concrete Filled Steel Tube Columns after Using CFRP Composites as Additional Reinforcement


Abstract:

This study proposed Carbon fiber reinforced polymers (CFRP) as additional transverse reinforcement at the critical zones of concrete filled steel tubular (CFST). An experimental study consisted of five main sets of specimens representing the ends of columns, such as those merging in through beam-column connections, was conducted. Each main set of specimens investigated the behavior of the concrete core for a specific case of CFST or CFRP wrapped CFST (CFCFST), and each main set comprised three similar specimens to get more accurate results. All specimens were 160 mm external diameter and 320 mm height and had the same concrete grade. The thicknesses of the steel tubes used were 2 and 3mm. The numbers of (CFRP) layers used were one and two layers. The results showed that one and two CFRP outer layers added to CFST greatly improved the concrete compression. Response showed 29% and 54% increase in the concrete core compressive strength, respectively. The increase in the steel tube thickness from 2mm to 3 mm caused 20% increase in the concrete core compressive strength. A new analytical model with a sufficient accuracy was driven to predict the concrete core strength for both CFST and CFCFST cases.

Keywords:

Concrete, Steel tube, Fiber reinforced polymer (FRP), Confinement, Buckling.

Published In:

IJEDR, Volume 6, Issue 2, ISSN: 2321-9939
-Numerical study of steel-to-FRP reinforcement ratio as a design tool controlling the lateral response of SFRC beam-column joints

Ibrahim, Haitham A.; Fahmy, Mohamed F.M.; Wu, Zhishen

Abstract:

NULL

Keywords:

NULL

Published In:

Engineering Structures, v 172, p 253-274
Exploratory study of adopting longitudinal column reinforcement details as a design-controllable tool to seismic behavior of exterior RC beam-column joints

Fahmy, Mohamed F.M.; Farghal, Omar A.; Sharobeem, Girgis F.G.

Abstract:

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Keywords:

NULL

Published In:

Engineering Structures, v 174, p 95-110