SHEAR RESPONSE INVESTIGATION OF HSRC DEEP BEAMS WITHOUT WEB REINFORCEMENT PART I: COMPARISON OF DESIGN EQUATIONS


Abstract:

Currently, there is no general agreement on a theory describing the response of reinforced concrete members without web reinforcement. Many structural systems are usually performed using empirical or semi-empirical expressions provided by codes of practice that do not consider the influence of many governing parameters. In this paper, a comparison between values of current experimental shear strength and those of various international design approaches like ACI, Canadian, FIB and the method proposed by Sudheer, Zararis, Zsutty, Shah, Bazant and Russo. Eighteen simple span high strength reinforced concrete (HSRC) deep beams without web reinforcement were tested and analyzed under two static point loads at mid-span of the beam to examine the contribution of various parameters on the shear capacity of HSRC beams. The main studied parameters are f"cu=50 MPa, three values of tension reinforcement-ρ%-(0.73%,1.21% &1.83%) and shear span to effective depth ratio-a/d-(2,1.5 &1). As a conclusion of this paper, ACI and FIB code provisions for shear in HSC are safe for use with the exception that CSA should be used with care. Despite numerous studies, there is still a need to develop a clear understanding of the shear behavior of HSC beams without web reinforcement. Therefore, this experimental program was arranged to evaluate the shear behavior and to increase the shear database on HSRC deep beams.

Keywords:

deep beams, high strength concrete, tension reinforcement ratio, shear span to effective depth ratio, shear strength.

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Shear response investigation of HSRC deep beams without web reinforcement. Part I: design equations

Ahmed Ramadan, Aly G. Aly Abd-Elshafy, Mahmoud H. Ahmed; Atif M. Abdel-Hafez

Abstract:

Currently, there is no general agreement on a theory describing the response of reinforced concrete members without web reinforcement. Many structural systems rely on design is usually performed using empirical or semi-empirical expressions provided by codes of practice that do not consider the influence of many governing parameters. In this paper, a comparison between values of current experimental shear strength and those of various international design approaches like ACI (FIP, 1996), Canadian (CSA, 1994), FIB (1999), and the method proposed by Sudheer (2011), Zararis (2003), Zsutty (1971), Shah (2009), Bazant (1984), and Russo (2005) have been calculated and analyzed on 18 simple span HSRC deep beams without web reinforcement were tested under monotonic two point loads at the mid span to examine the contribution of various parameters on the shear capacity of HSRC beams like; f'cu=50 MPa, three values of tension reinforcement (0.73%, 1.21% & 1.83%) and shear span to effective depth ratio-a/d-(2, 1.5 & 1) were selected to mainly study the behavior of deep beams, where typical shear failure can be anticipated. ACI and FIB code provisions for shear in HSC are safe for use with the exception that CSA should be used with care; it might have a tight safety margin against brittle shear failures.

Keywords:

- deep beam, high strength concrete, shear strength, tension reinforcement ratio, shear span to effective depth ratio, code design equations

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Shear response investigation of HSRC deep beams without web reinforcement. Part II Beam characteristics

Ahmed I. Ramadan, Aly G. Aly Abd-Elshafy, and Atif M. Abdel-Hafez

Abstract:

ACI code specifies the shear strength of deep beams based on the strength at the first diagonal crack of NSC beams without the consideration of beam size effect. Therefore, it is necessary to evaluate if the ACI design equation for deep beams is applicable to high strength reinforced concrete (HSRC) deep beams with main reinforcement ratio less and more than 1% with considering size effect or not. This paper is considered a supplement to the companion paper (Part I Comparison of Design Equations). Eighteen simple span HSRC deep beams without stirrups were tested to examine various parameters on the shear capacity; $f'_{cu}=50$ MPa, three values of main reinforcement, ($\rho_s$), (0.73%, 1.21% & 1.83%) and four values of shear span to overall depth ratio, ($a/h$), (0.84, 1.3, 1.7 & 2.3) were selected to mainly study the characteristics of deep beams. The increase in overall depth ($h$) under the same $a/h=1.3&1.7$, led to more brittle failure with wide diagonal cracks and high energy release rate related to size effects. HSRC deep beams exhibited more remarkable size effects with regard to brittle behavior. It was also shown that the ACI code gives similar safety factors on the shear strength at the first diagonal crack of HSRC deep beams, but do not specify a high enough safety factor on their ultimate strength due to the size effects.

Keywords:

depth beam, high strength concrete, first diagonal crack, ultimate strength, Beam characteristics

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(4)

Do ACI & JSCE codes emphasize the characteristics of high strength reinforced concrete deep beams or need reevaluation?

Ahmed I. Ramadan and Aly G. Abd-Elshafy

Abstract:

This paper summarize and analyze the shear characteristics of tested beams according to provisions of ACI & JSC codes which both of them specify the shear strength of deep beams based on the first diagonal crack strength of normal strength concrete NSC beams without taken into account the beam size effect. Hence, it is substantial to evaluate the applicability of JSCE & ACI shear design equations to high strength reinforced concrete (HSRC) deep beams with main steel ratio less and more than 1% with considering beam size effect or not. $f'c=60$ MPa, three values of main reinforcement, $(\%\%\%)$, (0.73, 1.21 & 1.83) and shear span to overall depth ratio, $(a/h)$, (0.84, 0.87, 1.3 & 1.7) were selected to study the shear characteristics of 18 simple span deep beams without stirrups. The increase in overall depth (h) under the same $a/h=1.3$ & 1.7, led to more brittle failure with wide diagonal cracks. HSRC deep beams exhibited more remarkable size effects with regard to brittle behavior. It was also shown that the ACI code gives similar safety factors on the shear strength at the first diagonal crack of HSRC deep beams, but do not specify a high enough safety factor on their ultimate strength due to the size effects.

Keywords:

deep beams, HSC, main steel ratio, shear span to effective depth ratio and shear strength

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Abstract:

The existing experimental work on FRP confined concrete column is mainly concentrated on concrete columns under concentric loading in recent years. Therefore this research involves the study of nonlinear FE analysis of FRP confined square and rectangular R.C. columns under both axial compressive and lateral loads. Lateral load was taken as a ratio of the axial compressive loads "H/ Pc". The results of this work were compared with previous work (Soghair, H.M. et al. 2004) considered the behavior of square and rectangular columns confined with CFRP under centric loads. All studied columns were modeled using the nonlinear finite element analysis. The main variables studied were the cross-section shape of the column "R", concrete grade "C", the percentage of area of the main longitudinal steel "As%" and the number of layers of CFRP sheet "NE". The FEM results indicated that R.C. columns externally wrapped with CFRP sheet showed a significant improvement in both capacity and ductility.

Keywords:

NULL

Published In:

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Evaluation of Shear Strength of HSRC beams without web reinforcement


Abstract:

Currently, there is no general agreement on a theory describing the response of reinforced concrete members without web reinforcement. Many structural systems rely on design is usually performed using empirical or semi-empirical expressions provided by codes of practice that do not consider the influence of many governing parameters. In this paper, a comparison between values of current experimental shear strength and those of various international design approaches [1-10] have been calculated and analyzed on 18 simple span HSRC deep beams without web reinforcement were tested under monotonic two point loads at the mid span to examine the contribution of various parameters on the shear capacity of HSRC beams like; $f'_{cu} = 50$ MPa, three values of tension reinforcement (0.73%, 1.21%, & 1.83%) and shear span to effective depth ratio (2, 1.5 & 1) were selected to mainly study the behavior of deep beams, where typical shear failure can be anticipated.

Keywords: NULL

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F.E.A OF R.C COLUMNS CONFINED BY CFRP LAMINATES UNDER AXIAL AND LATERAL LOADS

Hosny M Soghaïr, Mahmoud H Ahmed, Atif M Abdel-Hafez, Ahmed Ibrahim H Ramadan

Abstract:

Fiber reinforced plastic (FRP) jacketing has emerged as an effective way to retrofit concrete columns in recent years. The existing experimental work on FRP confined concrete column is mainly concentrated on concrete columns under concentric loading. Therefore, this research involves the study of nonlinear finite element analysis of FRP confined square and rectangular R.C. columns under both axial compressive and lateral loads. Lateral load was taken as a ratio of the axial compressive loads "H/ Pc". The effects of the FRP layer number, concrete compressive strength, percentage of main steel, rectangularity of columns and various ratios of lateral loads to centric load on FRP confined concrete columns were investigated theoretically. The results of this work were compared with previous work [1] considered the behavior of square and rectangular columns confined with CFRP under centric loads. All studied columns were modeled using the nonlinear finite element analysis. The main variables studied were the cross-section shape of the column "R", concrete grade "C", the percentage of area of the main longitudinal steel "As%" and the number of layers of CFRP sheet "NL". The FEM results indicated that R.C. columns externally wrapped with CFRP sheet showed a significant improvement in both capacity and ductility.

Keywords:

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Abstract:

Fiber reinforced plastic (FRP) jacketing has emerged as an effective way to retrofit concrete columns in recent years. The existing experimental work on FRP confined concrete column is mainly concentrated on concrete columns under concentric loading. Therefore, this research involves the study of nonlinear finite element analysis of FRP confined square and rectangular R.C. columns under both axial compressive and lateral loads. Lateral load was taken as a ratio of the axial compressive loads \( H/ P_c \). The effects of the FRP layer number, concrete compressive strength, percentage of main steel, rectangularity of columns and various ratios of lateral loads to centric load on FRP confined concrete columns were investigated theoretically. The results of this work were compared with previous work [1] considered the behavior of square and rectangular columns confined with CFRP under centric loads. All studied columns were modeled using the nonlinear finite element analysis. The main variables studied were the cross-section shape of the column \( R \), concrete grade \( C \), the percentage of area of the main longitudinal steel \( As\%\) and the number of layers of CFRP sheet \( NL\). The FEM results indicated that R.C. columns externally wrapped with CFRP sheet showed a significant improvement in both capacity and ductility.

Keywords:

NULL

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Conference: Al-AZHAR Engineering nine international Conference, At EGYPT, Volume: Vol.1 , 1 , NULL
Evaluation of Shear Strength of HSRC beams without web reinforcement

Ahmed Ibrahim Hassan Aly Gamal Ali Abd-Elshafy

Abstract:

Currently, there is no general agreement on a theory describing the response of reinforced concrete members without web reinforcement. Many structural systems rely on design is usually performed using empirical or semi-empirical expressions provided by codes of practice that do not consider the influence of many governing parameters. In this paper, a comparison between values of current experimental shear strength and those of various international design approaches have been calculated and analyzed on 18 simple span HSRC deep beams without web reinforcement were tested under monotonic two point loads at the mid span to examine the contribution of various parameters on the shear capacity of HSRC beams like; fcu=60 MPa, three values of tension reinforcement (0.73%, 1.21% &1.83%) and shear span to effective depth ratio (2, 1.5 &1) were selected to mainly study the behavior of deep beams, where typical shear failure can be anticipated.

Keywords:

deep beams, HSC, tension reinforcement ratio, shear span to effective depth ratio and shear strength

Published In:

Codified Comparative Assessment on Shear Strength of HSRC deep beams without stirrups

Ahmed Ramadan

Abstract:

Currently, Development of high strength reinforced concrete HSRC applications worldwide is going faster than the researches on it. Where, the shear mechanism of deep beams without stirrups still fully not understood due to its complicated behavior and conditions. In this paper, a comparative study on the shear mechanism of RC deep beams by considering values of current experimental shear strength and those calculated by international design approaches; ACI, CSA & FIB and also by the equations proposed by Sudheer, Zararis, Bazant, Zsutty, Russo and Shah. Eighteen simple span HSRC deep beams, practical size, without stirrups were tested under monotonic two point loads at the mid span to examine the contribution of various parameters on the shear capacity of deep beams. $f_c=80$ MPa, ($\%$) three values of main steel ratio ($0.73\%,1.21\% &1.83\%$), ($a/d$) shear span to effective depth ratio (2.1.5 &1) and constant beam width for all tested beams $b= 250$ mm were selected to mainly study the shear capacity and behavior of HSRC deep beams, where typical shear failure can be anticipated. As a conclusion of this paper, ACI and FIB code provisions for shear in High strength concrete (HSC) are safe for use with the exception that CSA should be used with care. Despite numerous studies, there is still a need to develop a clear understanding of the shear behavior of practical size of HSRC deep beams without web reinforcement. Therefore, this experimental program was arranged to evaluate the shear behavior and to increase the shear database on HSRC deep beams.

Keywords:

Deep beam, HSC, main steel ratio, shear span to effective depth ratio, shear capacity and design equations.

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Statistical Prediction Equations for RC Deep Beam Without Stirrups

Ahmed Ramadan Aly G. Aly Abd-Elshafy

Abstract:

Reinforced concrete (RC) deep beams mainly fail in shear, brittle and sudden in nature can lead to calamitous consequences. Thence, it is critical to determine the shear characteristics of RC deep beams accurately due to involving many parameters at same time. Some of the recent researches have shown that current equations for predicting ultimate shear strength are non-conservative when applied to high strength concrete (HSC) beams as well as some of design codes provisions. There are different approaches for analyzing the behavior of beams in shear. In this paper, a semi-empirical approach is adopted in which a database of existing experimental and literature results of deep beams, \( d > 300 \text{ mm} \) & \( d \)

Keywords:

Deep beams, Predictive design equation, Shear strength, Tension reinforcement ratio, Shear span to effective depth ratio

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