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Technical Report
Study of the Flexural Behaviour of Concrete Beams Reinforced with Steel Plates

HALEY LIN

Flexural Behaviour of Reinforced Concrete Slab CRC Press
This book compiles state-of-the-art information on the behavior, analysis, and design of concrete beams containing transverse openings. Discussions include the need, effects, and classification of openings as well as the general requirements for fulfilling design pure bending, combined bending, and shear - illustrated with numerical examples torsion alone or in combination with bending and shear large rectangular openings as well as opening size and location on beam behavior methods for analyzing ultimate strength and serviceability requirements effects of torsion in beams large openings in continuous beams and their effects on possible redistribution of internal forces as well as guidelines and procedures for the design of such beams effect of prestressing on the serviceability and strength of beams with web openings design against cracking at openings and

ultimate loads Concrete Beams with Openings serves as an invaluable source of information for designers and practicing engineers, especially useful since little or no provision or guidelines are currently available in most building codes.
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FLEXURAL BEHAVIOUR OF FIBRE REINFORCED POLYMER STRENGTHENED REINFORCED CONCRETE BEAMS AT ELEVATED TEMPERATURES. National Library of Canada
Confining existing concrete and masonry columns by Fibre Reinforced Polymers (FRP) is a beneficial method for enhancing the column capacity and ductility. The popularity of using FRP for strengthening and upgrading columns is mainly attributed to the high strength and lightweight characteristics of the FRP materials. Using FRP composites reduces additional dead load associated with traditional strengthening solutions and simplify the application in areas with limited access. The goal of this research is to experimentally quantify the enhancement in strength and strain capacity of Carbon FRP (CFRP) confined concrete masonry columns under concentric and eccentric loading. Research on FRP-strengthened concrete masonry columns under eccentric loads is essential to understand the effect of this retrofitting technique on the performance of columns. The experimental data was then used to propose a simplified methodology that predicts the axial force-moment interaction diagram of fully grouted reinforced concrete masonry column strengthened with FRP jackets. The methodology considers short prismatic reinforced concrete masonry columns failing in a compression controlled manner and complies with equilibrium and strain compatibility principles. To achieve the research goals, 47 scaled fully grouted

concrete block masonry columns were tested under concentric, eccentric, and bending loading up to failure. Parameters investigated in this research include the thickness of CFRP jacket, corner radius of cross section and the magnitude of eccentricity. The proposed analytical methodology showed a good correlation with the experimental data. Parametric study was carried out to determine the effect of design variables on the axial-flexural interaction of fully grouted reinforced concrete masonry column strengthened by FRP jackets.

Flexural Behaviour of Reinforced Concrete Beam Using Partial Synthetic Lightweight Coarse Aggregate (SYLCAG)

A vast development in the construction industries indicate the highly demand for the use of concrete. This also effect the depletion problem of natural coarse aggregate such as granite, crushed rock , and stone from the quarries. Thus, as an alternative to replace the natural coarse aggregate, synthetic coarse aggregate is produced to overcome the problem. This research involves the investigation of the flexural behavior of reinforced lightweight concrete beam made from synthetic lightweight coarse aggregate (SYLCAG). The SYLCAG is used to replace partially function of natural coarse aggregate. A reinforced concrete beam was tested in the flexural beam test using the four-point loads test. The compressive strength and the flexural behavior of the lightweight beam were two important parameters examined during the beam tests. The paper compares flexural performance of the lightweight beam and the normal beam in the term of failure modes, load deflection response, and ultimate load with those of the theoretical analysis. The theoretical results for ultimate load and deflection was predicted using equation provided by the ACI 318-05 building code and EC2. From the result, it shows that the SYLCAG concrete has slightly lower compressive strength and lower density than the normal concrete. The strength of SYLCAG concrete that was developed was about 93% from strength of control concrete. However the ultimate load of SYCLAG beam was 116% of the ultimate load of control beam. SYLCAG beam also has achieved 98% deflection of control beam and 79% deflection of the theoretical value. It can be conclude that the SYLCAG beam exhibit similar flexural behavior as that of normal concrete.

The Flexural Behaviour of Redundant Reinforced Concrete Frames

Basalt fibers have recently been introduced as a promising alternative to the existing fiber reinforced polymer (FRP) family. The mechanical properties of basalt FRP (BFRP) bars are, generally, better than those of glass FRP (GFRP) bars. However, they are still lower than those of carbon FRP (CFRP) bars. Also BFRP bars have now been developed that have a higher modulus of elasticity than typical GRFP bars. Only a limited amount of research is available on BFRP bars in structural concrete applications and there is no information on the performance of prestressed basalt bars in reinforced concrete elements subjected to fatigue loading. Most studies that are available deal only with the flexural behaviour of concrete beams reinforced with non-prestressed and prestressed GFRP and CFRP bars under monotonic and fatigue loading. This thesis presents an experimental study of the flexural behaviour of concrete beams reinforced with non-prestressed and prestressed basalt bars under monotonic and fatigue loading and compares these beam fatigue results with the fatigue behaviour of similar machined basalt rebars tested under fatigue loading in air. Sixteen beams with dimensions of (2400x 300x150mm) and thirteen BFRP bare rebars were tested. The parameters that varied were the level of prestress of the bars (0%, 20% and 40% of their static tension capacity) and the fatigue load ranges. The experimental findings showed a difference in the long life fatigue strength between the beams prestressed to 40% 20% and 0% of the bar strength with the beams with the bars prestressed to 40% of the bar strength showing a higher fatigue strength than of those prestressed to 0% and 20%. For 40% and 20 % prestressed beams, there is no benefit in fatigue performance above 20% and 13% of the ultimate capacity of the beams a level at which calculations showed that the remaining prestress did not close cracks at the minimum load in the fatigue load cycle. When compared on the basis of load range versus cycles to failure, the data for the three beam types fell onto a single curve at load levels where the remaining prestress after fatigue creep relaxation no longer closed the crack at the minimum load.

Fatigue Flexural Behaviour of Reinforced Concrete Beams with Non-prestressed and Prestressed Basalt Fiber Reinforced Polymer Bars

Fibre reinforced polymers (FRPs) have gained considerable popularity as a building and repair material. In particular, FRPs have been an economical means of extending the life of structures. As time passes, an increased number and variety of new and old structures are incorporating FRPs as reinforcement and for rehabilitation. Perhaps most common are their applications for bridge structures. Much of the reluctance towards the inclusion of FRP as primary reinforcement or as a rehabilitation measure in building structures is due to its poor performance in fires. In order to move forward with an understanding of how FRP may overcome its temperature-related short comings, it is important to explore the behaviour of FRP, and structures which utilize FRP for reinforcement, at elevated temperatures. The results of a testing program including eleven high temperature, two room temperature intermediate-scale, FRP-strengthened, and one unstrengthened reinforced concrete beam tests are presented. The elevated temperature tests were conducted on both un-post-cured and post-cured FRP strengthening at temperatures up to 211°C. The tests also utilized a novel method for heating and post-curing FRP-strengthening in place. The strengthened beams exhibited strength gains above the unstrengthened reference beam, and it has been demonstrated that post-curing of an FRP system can be effective at increasing an FRP's performance at elevated temperatures. Exposed to constant temperatures, un-post-cured specimens still exhibited substantial FRP strength at exposure temperatures up to Tg+79°C. Post-cured specimens exhibited similar performance at temperatures of Tg+43°C. The transient temperature tests resulted in ii beam failure at an average temperature of 186°C and 210°C for un-post-cured and post-cured FRP strengthening respectively at a constant applied load level 93% of that of the room temperature strengthened control beam.

The results of this testing program demonstrate that FRP strengthening can remain effective when exposed to temperatures well above the measured value of Tg.

Flexural Behaviour of Reinforced Concrete with Rectangular Hollow Section

Flexural behaviour is one of the element in determine whether the materials involve in the case study can be used as part of the structure. This study reported on the flexural behaviour of reinforced concrete beams construct from synthetic lightweight coarse aggregate (SYLCAG) produced from offshore sand which is used as alternative to replace normal weight aggregate where they are over exploited nowadays. The development of this study were experimentally to determine the capabilities of the offshore sand as synthetic lightweight coarse aggregate (SYLCAG) used in structural reinforced concrete. Compressive strength test were carried out to determine the strength of concrete using SYLCAG. Flexural strength test were carried out with increasing load using four point load test method until the designed reinforced beam fails. The load applied and deflection were recorded in timely manner. Experimental ultimate load capacity and deflection were then compared with the theoretical calculations which calculated from Eurocode 2 for the ultimate load capacity and ACI code or the deflection. The cracks occurred are visualised to determine the mode of failures. This study find that concrete made of SYLCAG has low strength. Other than that, for the four point test, SYLCAG reinforced concrete beam has shown lower load capacity can be taken before the beam fail as about 50% of the normal concrete design of the same strength. At early stage, SYLCAG concrete show positive failure mode and as the load apply increased, it tend to have failure mode in shear.

Flexural Behaviour of Reinforced Concrete Beams at Working Loads

Reinforced concrete beam is a simple structure that commonly used in a structural building. In this report some of the formula for hollow reinforced concrete beam will be come out from the basic formula. Then laboratory test was carried out to prove the theory that concrete beam will not fail below the design load. This test is very important to prove as practically that the beam can be used in structural building. Because of the factor of time there are some parameters cannot be included in his project. Creep and shrinkage need more time to be considered in this project so it has been neglect because the factor of time. There are others problem that need to be considering like the difficulty to find the formula for hollow section. This problem can be solved using the basic formula. All the basic formula is according to BS8ll O. From the laboratory test hollow reinforced concrete beam is not failure below the design. The objective of this project to show that hollow reinforced concrete beam is not failure below the design and can be used in structure is successfu1. From the analysis, the objectives to find the maximum hollow to be used as long as beam is not failure below the design also have been successfu1.-Author.

The moments at gauged sections were evaluated by means of a digital computer program. Strains measured on the surface of the concrete and the tensile reinforcement were related to parameters determined from compressive tests on concrete cylinders. The resistance moment, force and other quantities appertaining to the section were calculated for all states of loading over the entire range of behaviour up to collapse. Unlike methods utilising moment-curvature relationships subsidiary tests to determine these characteristics were not required. The data used were obtained from tests on control samples of reinforcement and concrete. A least squares curve fitting routine was used to produce a second order best fit strain profile for the strains measured across a given section. The second order profile being preferred to the more usual straight line assumption as it enabled the position of the neutral axis to be related to both tensile and compressive strains measured on the section. A mathematical model for the concrete was set up in the computer based on the data from the control tests on the concrete cylinders. This model and the strain profile were then combined on the basis of the extreme fibre strain and the depth of the neutral axis to calculate the moment of resistance, force and curvature for the section. The value of the strain on the tensile reinforcement was compared with the strain in the concrete at that level to enable the moment of resistance in tension to be calculated and compared with the moment of resistance in compression. Tests were carried out on a series of simply supported beams to prove the approach. For the beams tested the proportion of mild steel tensile reinforcement varied from 0.4% to 5.0% of the cross-sectional area.......

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