RC ELEMENTS UNDER CYCLIC LOADING pdf

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*Rc Elements Under Cyclic Loading: State of the Art Report [Comit E. Euro-International Du B. Eton] on www.enganchecubano.com *FREE* shipping on qualifying offers. This guide provides a thorough review of the pertinent existing knowledge in the area of constitutive modelling of concrete steel bonds and of their interaction.*

The input parameters and output results are presented in the following sections. Model Calibration Basic properties of the specimen with model discretization are shown on Figure E1. Detailed information about the test specimen can be found in paper by Tran and Wallace , whereas details of model calibration are provided by Kolozvari and Kolozvari et al. Input Files Input files. Analysis Results The following sub-section presents analytical results obtained for the test specimen described above, using the input files provided. The results include global wall responses compared against experimental results , model element responses, and individual RC panel macro-fiber responses. Global Wall Responses Analytical and experimental lateral load versus top total displacement responses and wall cracking patterns are presented on Figure E1. Load versus Deformation Behavior for: Model Element Responses Figure E1. Responses are recorded using globalForce, ShearDef, and Curvature element recorders. Total Deformation, b Shear force vs. Flexural Deformation, c Shear Force vs. Shear Deformation, d Moment vs. Reinforced Concrete Panel Responses Various stress-strain responses for an individual boundary panel element outermost macro-fiber within the bottommost wall element are presented, including total resultant stress vs. Panel Total Stress vs. Predicted Stress-Strain Behavior for Concrete: Predicted Stress-Strain Behavior for Steel: Analytical model of a coupled wall-frame building system was generated and analyzed under a single ground motion time-history. Brief description of the building characteristics and the analytical model are provided in the following sections. Analysis is conducted for shaking in the transverse direction only, where the lateral-force-resisting elements include two identical one-bay frames located at the building perimeter axis 1 and 8, Figure E2. Cross-sections of structural elements with the reinforcement detailing are provided in Figure E2. Analytical Model Description Due to building symmetry and applied direction of the ground motion, a two-dimensional model consisting of one frame and one wall Figure E2. The gravity system is not included in the model ASCE and the assumption of a rigid diaphragm is implemented within each story level. Tributary mass is assigned at the element nodes at each story level at locations of axes of the vertical elements i. As show on Figure E2. Wall discretization in horizontal direction was performed using six macro-fibers to represent the wall cross section, where two outer macro-fibers were used to represent the confined wall boundaries and the remaining four represent the unconfined wall web. Material models for steel and concrete are calibrated based on adopted material strengths to represent the behavior of confined and unconfined concrete and reinforcing steel. RC frame elements i. The reduction of flexural stiffness after cracking was considered using stiffness modifiers for elastic portions of beam and column elements according to ASCE 41 Table 6. Analytical Model of Building System: Dynamic Analysis Results Results obtained using analytical model of the building described in the previous section are presented, including modal properties of the structure, wall global i. Responses of the structural elements comprising the RC frame are not considered. Dynamic Properties First two building fundamental periods and mode shapes are presented in Figure E2. Time-history Responses Time histories of ground motion acceleration, wall top nodal displacement, and wall base shear force bottom wall node reaction are presented in Figure 2. Global Building Responses E2. Maximum Global Responses over the Wall Height Maximum envelopes of wall lateral displacements and interstory drifts, and shear force and bending moment are presented in Figure E2. Wall lateral displacements and drifts are obtained using corresponding node recorders, disp and drift, whereas shear force and bending moments over the wall height are recorded using element recorders globalForce. Displacement, b Lateral Load vs. Flexural Deformation, c Lateral Load vs. Single RC Panel Responses Analytically-predicted strain-stress responses of a single RC panel macro-fiber located at the left wall boundary of the bottom wall element are presented. Global panel stress-strain relationships presented on Figure E2. Other panel responses described in Section 3 could be plotted in a similar manner. Similarly, the distribution of other wall responses could be plotted over the wall height e.

Local Responses - Vertical Profiles of Maximum: The curvature of the transition curve between the two asymptotes is governed by a cyclic curvature parameter R, which permits the Bauschinger effect to be represented, and is dependent on the absolute strain difference between the current asymptote intersection point and the previous maximum or minimum strain reversal point depending on whether the current strain is increasing or decreasing, respectively.

2: A State of the Art Review on the Behavior of Reinforced Concrete (RC) Beams under Cyclic Loading

rc elements under cyclic loading This guide provides a thorough review of the pertinent existing knowledge in the area of constitutive modelling of concrete steel bonds and of their interaction. It discusses the problems encountered in assembling the various elements with the purpose of constructing the model of an element made of reinforced.

ABSTRACT In the last two decades, the study of reinforced concrete RC structures elements such as bridge deck slabs, bridge girders, or offshore installations, which are subjected to cyclic action typically induced by seismic motions has received the attention of many researchers. Moreover, several theoretical and empirical models have been proposed for evaluating the shear strength of beams, columns and beam-to-column joints. In this paper, an overview of the models currently available in the scientific literature for evaluating the shear capacity of beams, columns and exterior beam-to-column joints is reported. Further, important practical issues which contribute in shear strengthening of structures with different element types especially RC beams with different strengthening techniques, such as steel plate and FRP laminate are discussed. Finally, directions for future research based on the existing gaps of the existing works are presented. Introduction Reinforced concrete RC structures are commonly designed to satisfy two criteria: To ensure the serviceability requirement, it is necessary to accurately predict the cracking and deflections of RC structures under working loads. The design of reinforced concrete structures is subjected to cyclic loadings such as bridge deck slabs, bridge girders, or offshore installations necessitate the consideration of fatigue. These structures typically experience millions of stress cycles during their service life; the cyclic load can be detrimental to their structural performance [1]. Recently, the study of reinforced concrete structures sections subjected to cyclic action typically induced by seismic motions has received the attention of many researchers. Furthermore, to assess the safety of structures against failure, an accurate estimation of the ultimate load is essential. In particular, to arrive at a complete assessment of the strength, stiffness, and ductility of existing structures and newly designed critical structures such as long-span bridges and tall buildings, a nonlinear dynamic analysis has been strongly required. The Importance of Structures Repairing and Strengthening Repairing and retrofitting of existing RC structures represent one of the key issues in modern seismic engineering. Recent earthquakes have repeatedly demonstrated the inadequate protection level toward both damage and collapse of the existing buildings. Given the high economic cost of demolishing and rebuilding under designed structures, the current trend is to recover these structures by improving the flexural and shear strength of some members and increasing their local or global ductility. Application of FRP for columns and beams showed in Figure 1. Conventional FRPs have a linear elastic stress-strain response followed by brittle rupture at a relatively small rupture Figure 1. FRP strengthening of a columns b beams. Previous Experimental Studies 2. As it known well, the shear failure of RC beam is sudden and brittle in nature. It is less predictable and gives no advance warning prior to failure. Shear failure is more dangerous than the flexural failure. It is why the RC beam must be designed to develop its full flexural capacity to assure a ductile flexural failure mode under extreme loading. Width of the CFRP straps, arrangements of straps along the shear span, and anchorage techniques considered as main experimental parameters. Results showed that, when strengths of the specimens in experimental program were investigated, the effects of strengthening with CFRP straps on strength were closely related with the arrangements of CFRP straps, concrete strength, and whether anchorages were applied or not. They compared the results suggested by ACI Committee report with the experimental ones. The cyclic test results also confirmed the usefulness of an empirical equation previously proposed to assess the shear strength of reinforced concrete haunched beams, taking into account parameters such as the haunch angle, the concrete compressive strength, the shear reinforcement and the contribution of the inclined longitudinal reinforcement. An experimental campaign based on four reinforced concrete beams subjected to reverse three-point bending tests was presented by R. From the numerical results obtained, it appears that the use of refining constitutive models at the material scale allows decreasing the contribution of the viscous damping matrix drastically. Hybrid FRP bonded-reinforced concrete beams subjected to quasi-static cyclic loading in an attempt to represent the effect of repetitive loading were presented by Hasan Nikopour, M. Many parameters were measured and compared with predictions of a computational model based on finite element analysis. Their Experimental results demonstrated that hybrid applications of FRP sheets could improve the shear performance of retrofitted RC beams and increase the ultimate strain of the FRP sheets at failure. The theoretical results were in reasonable agreement with the corresponding experimental results. The behavior of steel-fibre-reinforced concrete beams under cyclic loads was studied by A. Syed Mohsin and D. They reported that the use of steel fibres could result in a significant reduction in conventional reinforcement without compromising ductility and strength requirements. The investigations provided insight into how the steel fibres can help reduce the amount of conventional shear links. The numerical model was calibrated against existing experimental data to ensure the reliability of its predictions. Parametric studies were subsequently carried out using the full practical range of steel fibre dosages. Load-deflection curves, crack load and at ultimate load were established. Finite element models ANSYS was used to validate the experimental investigations with the analytical studies. The effect of different amounts of longitudinal reinforcement, shear stiffness and transverse reinforcement on behavior is highlighted as main parameters. The shear performance of RC beams strengthened in shear with externally bonded carbon fiber-reinforced polymer CFRP strips subjected to a cyclic loading for two million cycles at 1 Hz is investigated by Sang-Wook Bae et al. Results obtained from experimental study compared with that in the existing literature and showed that RC beams strengthened in shear with externally bonded CFRP could survive two million cycles of cyclic loading without failure. Moreover, shear strengthening by CFRP strips increased the shear strength by Eight simply supported RC beams containg edge opening, with and without repairing were studied by Saad Khalaf Mohaisen, et al. Afsin Canbolat, et al. The test results showed that HPFRCC coupling beams with simplified diagonal reinforcement exhibited higher shear strength and stiffness retention. The effects of transverse steel reinforcement corrosion on the seismic behavior of RC beams designed conforming to the ACI seismic design provisions, and with a moderate shear stress level and an equal amount of tension and compression longitudinal reinforcement were examined experimentally by Yu-Chen Ou, et al. Georges El-Saikaly, et al. The specimens were subjected to fatigue loading up to six million load cycles at a rate of 3 Hz. The results demonstrate the effectiveness of the EB-FRP shear strengthening technique for extending the service life of RC beams under fatigue loading. The presence of transverse steel in retrofitted beams resulted in a substantial gain reduction in shear resistance due to CFRP, confirming thereby the existence of an interaction between internal transverse steel and EB-CFRP. Moreover, the experimental tests on fatigue behavior of the performance steel-fiber-reinforced concrete SFRC beams were conducted [16]. Six steel reinforced beams with various transverse reinforcement ratios, engineered cementitious composite ECC thicknesses, and shear span-depth ratios were tested under reversed cyclic loading [17]. Experimental results show that the steel reinforced ECC beams show better seismic performance regarding load carrying capacity, shear resistance, energy dissipation capacity and damage tolerance compared with steel reinforced concrete beams. Results concluded that cyclic loading caused insignificant variations in beam stiffness and, as a consequence, insignificant variations in the mechanical parameters [19] [20]. Experimental studies have been conducted on the behavior of FRP confined concrete under cyclic axial compression and the theoretical models for predicting such behavior in the open literature was developed [21] [22] [23] [24] [25]. Determination of shear distortions is necessary to accurately estimate the total coupling beam deflection particularly at displacement values exceeding yield. Shear distortions are likely affected by the extent of diagonal cracking in the beams. So the variation of shear stiffness as a function of displacement demand was measured throughout the tests. Beam-Column Joints Beam-column joints are critical regions of reinforced concrete frames designed for inelastic response to the seismic attack. Inadequately detailed joints especially exterior beam-column joints Figure 2 may fail prematurely in a brittle manner due to high shear stresses. In earthquake-prone regions, the joints of ductile moment resisting DMR frames must be designed and detailed to allow large energy dissipation in adjacent plastic hinges without a significant loss of strength and ductility. Figure 2 and Figure 3 showed the beam-column and frame joints, respectively. They evaluated the connection parameters effect such as angle thickness, bolt configuration, weld type and size, supplementary seat angle and end plate thickness. Results showed that the presence of each parameter contributes in shear strength increasing. The cyclic behavior of three-story steel plate infilled walls SPIW that are composed of reinforced concrete boundary frames was investigated by In-Rak Choi, et al. Results indicated that thin steel infill plates could be Figure 3. The repair of two hybrid RC column-to-steel beams RCS connections severely damaged during earthquake type displacements is described by Gustavo J. The behavior of the repaired specimens is compared to that of the original specimens in terms of load-versus-displacement response, lateral stiffness, joint shear distortion, strains in the joint, transverse reinforcement and longitudinal column bars. They concluded that the growth of diagonal cracks and prevented FRP sheets controlled spalling of concrete in the corners of the joint. Roberto Realfonzo et al. They concluded that the tests on repaired joints have confirmed the efficiency of the selected strengthening solutions and provided useful information on the adopted strengthening systems in terms of strength, ductility, and energy dissipation capacity of RC beam-column joints. The experimental investigations on two types of simple mechanical concrete beam-column connections subjected to reverse cyclic loading were carried out by R. The load ratio, energy dissipation, ultimate load-carrying capacity, hysteretic behavior, equivalent viscous damping ratio, ductility factor, and strength degradation of both the precast and monolithic specimens were considered as main parameters. The results showed that ultimate load-carrying capacity of the monolithic specimen was superior to that of both the precast specimens. Results show that the strengthening techniques and the axial loads applied on columns can have a significant influence on the seismic behavior of the joints. The results show that the method used in their study is effective and capable for restoring or even upgrading the strength of the RBCJ. In addition, using the basic principles of equilibrium and compatibility and an analytical model is presented the simplified analysis and design of this strengthening scheme. An experimental program concerned with the response of RC walls under cyclic loading is presented by Kypros Pilakoutas et al. The discussion of the experimental results and comparisons between experimental and analytical work are presented. Cyclic behavior of RC cantilever walls was presented by Kypros Pilakoutas et al. The stiffness characteristics of RC members determine the level of loading likely to be imposed and guidance is given as to suitable load reduction factors. Limit states and deformational characteristics are investigated, and observations are discussed. In particular, two levels of the axial load were considered. They concluded that the total energy dissipated by the columns strengthened with FRP systems is much higher than that evaluated for the unstrengthened ones. Unconfined and confined members dissipate a comparable amount of energy until the collapse of the unconfined columns is achieved. A full-scale RC structural wall subjected to cyclic loading designed according to European Seismic Code are studied experimentally by P. The results show that the collapse mechanism was governed by shear with the formation of a single large crack near the base section, almost parallel to the ground floor diaphragm leading to the tensile necking failure of the longitudinal wall reinforcement. Distributions of unit strain and curvature obtained with a dense array of non-contact coordinate-tracking targets at same wall are also presented [38] [39]. Test results show that the shear failure of the transverse beam at the first floor has been observed with a typical cracking pattern. Analytical Studies A review of existing analytical studies relevant to the seismic response of RC structures is presented in the following. Jin-Wook Hwang et al. They concluded through correlation studies between analytical results and experimental data that the inclusion of the bond-slip effect is important in evaluating the energy absorption capacity as well as the ultimate resisting capacity and the proposed model can be effectively used to predict the structural response under cyclic loading, and its application can be extended to a dynamic analysis of frame structures. The first-ever study on the behavior and modeling of FRP-confined concrete under cyclic axial compression was presented by Yu-Lei Bai et al. A cyclic stress-strain model is then proposed and shown to provide close predictions of the test results. The proposed cyclic stress-strain model is formed by combining an existing monotonic stress-strain model for predicting the envelope curve with an existing cyclic stress-strain model for predicting the unloading and reloading paths. The behavior of beams in which plastic hinges are formed under cyclic loading is examined by R.

3: FSAM - 2D RC Panel Constitutive Behavior - OpenSeesWiki

This text provides a review of relevant knowledge in the area of constitutive modelling of concrete steel bonds and their *interaction. It discusses the problems encountered in assembling the various elements with the purpose of constructing the model of an element made of reinforced concrete.*

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