ANALYSIS OF RCC STRUCTURES WITH AND WITHOUT FLOATING COLUMN

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Abstract- The term floating column is a vertical member who ends at its lower level rests on a beam which is a horizontal member. The beams in turns transfer the load to other column below it. In present scenario buildings with floating column is a typical feature in the modern multistory construction in India. In present paper effort has been taken to review the behavior of building with floating column.
Test model was built, with specified specification. Vibration sensor was developed to measure the vibration amplitude. CAD model was created with all specification of test model to match the desired condition. Simulated environment was developed with all the boundary condition. Compared the result of both simulation and experiment. Data analysis is evaluated. It was observed that in building with floating column has more time period as compared to building without floating columns, in building with floating column has less base shear as compared to building without floating column, The displacement floating column building is more as compared to without floating column building, on shifting of floating column from 1st storey towards top storey of the building results in increasing store drift, From dynamic analysis it was observed that floating column at different location results into variation in dynamic response, It was also observed that shifting of floating column from 1st storey towards top storey of the building results in increasing base shear.

Keywords- Floating and Non – Floating Columns, G5+ Building, EQNX, EQPY, WLX, and Storey drift.

1. INTRODUCTION

Reinforced concrete (RC) (also called reinforced cement concrete or RCC) is a composite material wherein concrete's fantastically low tensile power and ductility are counteracted by the inclusion of reinforcement having higher tensile energy or ductility. The reinforcement is typically, even though not always, steel reinforcing bars (rebar) and is commonly embedded passively within the concrete earlier than the concrete sets. Reinforcing schemes are typically designed to resist tensile stresses especially regions of the concrete that would reason unacceptable cracking and/or structural failure. Modern bolstered concrete can incorporate various reinforcing materials product of metallic, polymers or exchange composite fabric in conjunction with rebar or no longer. Reinforced concrete will also be permanently burdened (concrete in compression, reinforcement in tension), for you to improve the behavior of the final structure below running loads. In the US, the most not unusual strategies of doing this are known as pre-tensioning and put up-tensioning. Reinforced concrete (RC) is a versatile composite and one of the maximum extensively used substances in contemporary production.

Behavior of reinforced concrete

- Materials – Concrete is a mixture of Coarse (stone or brick chips) and excellent (generally sand or crushed stone) aggregates with a paste of binder material (commonly Portland cement) and water. When cement is mixed with a small amount of water, it hydrates to form microscopic opaque crystal lattices encapsulating and locking the combination into a rigid shape. The aggregates used for making concrete ought to be loose from dangerous substances like natural impurities, silt, clay, lignite and so on. Typical concrete mixes have excessive resistance to compressive stresses (approximately 4,000 psi (28 MPa)); but, any considerable anxiety (e.g., due to bending) will damage the microscopic inflexible lattice, resulting in cracking and separation of the concrete. For this motive, regular non-reinforced concrete have to be properly supported to prevent the improvement of tension. If a cloth with excessive strength in tension, which includes steel, is placed in concrete, then the composite fabric, reinforced concrete, resists now not only compression however also bending and other direct tensile movements. A composite phase in which the concrete resists compression and reinforcement "rebar" resists tension may be made into almost any form and length for the construction industry.
- Key characteristics – Three physical characteristics give reinforced concrete its special properties:
- The coefficient of thermal growth of concrete is similar to that of steel, putting off large internal stresses due to variations in thermal enlargement or contraction.
- When the cement paste within the concrete hardens, this conforms to the floor info of the metallic, allowing any strain to be transmitted efficiently between the unique substances. Usually metal bars are roughened or corrugated to further improve the bond or cohesion between the concrete and steel.
- The alkaline chemical environment furnished through the alkali reserve (KOH, NaOH) and the portlandite (calcium hydroxide) contained inside the hardened cement paste reasons a passivating film to shape at the surface of the metallic, making it an awful lot greater resistant to corrosion than it might be in impartial or acidic conditions. When the cement paste is exposed to the air and meteoric water reacts with the atmospheric CO2, portlandite and the calcium silicate hydrate (CSH) of the hardened cement paste turn out to be gradually

carbonated and the high pH step by step decreases from 13.5 – 12.5 to 8.5, the pH of water in equilibrium with calcite (calcium carbonate) and the metallic is no longer passivized.

- Mechanism of composite action of reinforcement and urban – The reinforcement in a RC shape, which include a steel bar, has to undergo the same stress or deformation as the encompassing concrete which will save you discontinuity, slip or separation of the two materials below load. Maintaining composite movement calls for switch of load among the concrete and steel. The direct stress is transferred from the concrete to the bar interface in an effort to exchange the tensile pressure within the reinforcing bar alongside its duration. This load transfer is accomplished via bond (anchorage) and is idealized as a non-stop stress discipline that develops in the place of the metallic-concrete interface.
- Anchorage (bond) in concrete: Codes of specifications – the real bond stress varies alongside the period of a bar anchored in a zone of anxiety, contemporary worldwide codes of specifications use the idea of improvement period in place of bond stress. The most important requirement for protection in opposition to bond failure is to provide a sufficient extension of the length of the bar past the point where the steel is needed to develop its yield stress and this duration must be at least same to its improvement duration. However, if the real available length is insufficient for full development, unique anchorages must be provided, along with cogs or hooks or mechanical end plates. The same concept applies to lap splice length mentioned in the codes where splices (overlapping) provided between two adjacent bars in order to maintain the required continuity of stress in the splice zone.
- Anti-corrosion measures –In wet and cold climates, Strengthened concrete for roads, bridges, parking structures and different systems that can be exposed to deicing salt can also benefit from use of corrosion-resistant reinforcement which includes uncoated, low carbon/chromium (micro composite), epoxy-covered, hot dip galvanized or chrome steel rebar. Good layout and a nicely-chosen concrete mix will offer additional protection for lots programs. Uncoated, low carbon/chromium rebar looks much like general carbon metallic rebar due to its lack of a coating; its fairly corrosion-resistant capabilities are inherent inside the metallic microstructure. It may be identified through the unique ASTM exact mill marking on its clean, darkish charcoal end. Epoxy coated rebar can without problems be identified by using the mild green coloration of its epoxy coating. Hot dip galvanized rebar may be vibrant or dull grey depending on duration of exposure, and stainless rebar reveals an average white steel sheen that is effectively distinguishable from carbon metal reinforcing bar. Reference ASTM trendy specs A1035/A1035M Standard Specification for Deformed and Plain Low-carbon, Chromium, Steel Bars for Concrete Reinforcement, A767 Standard Specification for Hot Dip Galvanized Reinforcing Bars, A775 Standard Specification for Epoxy Coated Steel Reinforcing Bars and A955 Standard Specification for Deformed and Plain Stainless Bars for Concrete Reinforcement.

2. LITERATURE REVIEW

KirankumarGaddadet al. [1] [2010]Thefracture behavior of fiber-reinforced roller-compacted concrete (RCC) specimens are examined, with mono and hybrid fiber (different type and length). The changed parameter version (MTPM) turned into employed to calculate Mode I simple-strain fracture toughness that's able to recall the viable crack deflection (kinked crack). The effects showed that for a great amount of kinked attitude, the utility of the two-parameter model (TPFM) instead of MTPM motive to an overestimation of the fracture durability values. Furthermore, the addition of fibers to the RCC mixture does no longer drastically affect the prevalence of the likely kinked crack in the course of stable crack propagation. Based on 3-factor bending test outcomes on notched beam, there's a fine synergy effect between short metal fibre and macro-polypropylene fibers on fracture durability. In post-cracking extension, the large and strong steel fibre was the most influential in bridging macro-cracks.

Ryoheishikuraet al. [2][2018] This paper Evaluated the Shrinkage precipitated curvatures in reinforced concrete elements are idea to be affected most effective by phase geometry and distribution/ratio of reinforcement. The variant within the level of internal restraint caused by the non-uniform distribution of concrete constituents within the segment, but, also can cause additional shrinkage brought on deformations, and probably to larger than predicted deformations in critical structural factors, even underneath carrier situations. This study examines experimentally the improvement of non-uniform shrinkage traces in unreinforced as well as symmetrically and asymmetrically reinforced concrete elements. Results verify that shrinkage is non-uniform because of the versions in inner restrains (coarse aggregates and reinforcement). The addition of metal fiber mitigates this impact and decreases typical shrinkage curvature. A prediction model for shrinkage precipitated curvature of plain and bolstered concrete is proposed, contemplating the non-uniform distribution of concrete ingredients. The proposed version yields outcomes in right settlement with experimentally observed values ofshrinkage curvature and can be used to enhance the predictions of design guidelines.

Agbomerie Charles Odijie[3][2017] Thistechnology is quite unwanted in building constructed in earthquake active regions. This look at gives understanding approximately the significance of presence of the floating column in the evaluation of constructing. These studies are approximately stiffness balance of the first storey and the storey above, and are proposed to reduce the irregularity delivered by means of the floating columns. This take a look at is associated with floating column placed on lengthy span transfer beam. For the examine of homes with floating column we used FEM codes for 2D multistory frames to study the responses of the shape below extraordinary earthquake excitation having different frequency content retaining the time period factor constant. The time history of floor displacement, inter storey waft, base shear, overturning moment are computed forthe frames with floating column.

Meghana B .S. and T.H. Sadashiva Murthy [4][2016]This pulse can reason full-size harm for the duration of an earthquake, especially to structures with herbal intervals close to those of the heartbeat. Failures of modern-day engineered systems determined in the close to-fault vicinity in recent earthquakes have found out the vulnerability of current RC homes against pulse-kind ground motions. This may be due to the reality that these modern-day structures had been designed mainly the usage of the design spectra of to be had standards, which have been advanced the usage of stochastic approaches with especially lengthy length that characterizes extra distant floor motions. Many these days designed and constructed homes may additionally therefore require strengthening in an effort to carry out properly when subjected to near-fault floor motions. Fiber Reinforced Polymers are considered to be a viable alternative, due to their relatively clean and brief set up, low existence cycle expenses and 0 upkeep requirements.

Xiao-hua Wang et al. [5][2016]This research pursuits to make clear and advantage an perception into the impact of the period of the stiffened core and the energy of the deep cement mixing (DCM) socket on the behaviors of floating stiffened deep cement mixing (SDCM) columns. The discovered behaviors encompass the axial ultimate bearing capacity, agreement and failure mode. The look at starts through accomplishing a series of bodily model tests as a initial investigation. The effects screen that the power of the DCM socket may be decreased to a certain cost by means of placing a sufficiently long bolstered core to acquire the best viable load-wearing potential, indicating an highest quality length of the stiffened center for a particular DCM socket electricity. For a parametric examine on the actual scale circumstance, full-scale load exams on a floating DCM and an SDCM column with eucalyptus wooden as a core in the thick smooth clay layer area were done to offer a reference case. The prolonged numerical evaluation effects advocate that the modes of failure depend upon the period of the stiffened core and the energy of the DCM socket. The outcomes from the numerical parametric take a look at have been used to set up a guiding principle chart for suggesting the best period of the core in accordance with the strength of the DCM socket of the floating SDCM columns. The subject pile load take a look at effects also affirm that core substances with a decrease strength and stiffness, which includes eucalyptus timber, could potentially be used as a bolstered center.

K.-W. Liu and R. Kerry Rowe [6][2015]The susceptible bonding interlayers in curler compacted concrete (RCC) have tremendous have an effect on on the physical and mechanical behaviors for its layered structure. However, much less attention has been paid to the stress wave propagation throughout interlayers under effect loadings. In this paper, the break up Hopkinson Pressure Bar (SHPB) is used to research the stress wave propagation throughout RCC, characterized by reflection and transmission coefficients. It is observed that the strain wave propagation across RCC is stimulated by using the interlayer and reveals apparent strain-fee sensitivity below effect loadings. Furthermore, an equivalent viscoelastic medium version is usually recommended to investigate the stress wave propagation across RCCspecimen, which verifies that the wave attenuation lies inside the nonlinear deformation behavior of RCC. The theoretical transmission coefficient of strain wave in SHPB check is negatively associated with relative wave impedance, wave attenuation coefficient and specimen duration. Besides, an awful lot much less wave attenuation will occur whilst RCC specimens are uncovered to higher stress-rate loadings. This paper in addition interprets the mechanism for the dynamic behaviors of layered RCC in term of pressure wave propagation and suggests the potential of interlayers to hinder the wave propagation efficiently.

H. Rooholaminiet al. [7][2010]Retrofitted an eight-storey body bolstered previously with a metal bracing device with internet- bonded CFRP. Comparing the seismic overall performance of the FRP retrofitted frame at joints with that of the steel X-braced retrofitting technique, it changed into concluded that both retrofitting schemes have comparable skills to boom the ductility reduction issue and the over-strength issue; the previous comparing better on ductility and the latter on over-electricity. The metallic bracing of the RC frame may be useful if a sizable increase inside the stiffness and the lateral load resisting capability is required. Similarly, FRP retrofitting at joints may be used together with FRP retrofitting of beams and columns to attain the desired will increase.

Zahran Al-Kamyani et al [8] [2010]Tested a full-scale two-storey RC building with poor detailing inside the beam column joints on a shake desk as a part of the European research project ECOLEADER. After the preliminary assessments which broke the shape, the body turned into bolstered using carbon fiber strengthened materials (CFRPs) and re-examined. This paper investigates analytically the efficiency of the strengthening technique at improving the seismic behaviour of this body shape. The experimental records from the initial shake table exams are used to calibrate analytical fashions. To simulate deficient beam column joints, models of steel concrete bond slip and bond-strength degradation beneath cyclic loading had been taken into consideration. The analytical models have been used to assess the performance of the CFRP rehabilitation the use of a hard and fast of medium to robust seismic facts. The CFRP strengthening intervention betters the behavior of the substandard beam column joints, and resulted in significant improvement of the seismic overall performance of the broken RC body. It turned into proven that, after the CFRP intervention, the broken building might enjoy on average 65% much less global damage compared to the original structure if it became subjected to real earthquake excitations.

3. FINITE ELEMENT METHOD

Sometimes, it becomes difficult to contemplate the behavior of a system when it is studied as a whole. On the other hand, it becomes relatively easier to study such system, by dividing it into its individual components and subcomponents. The behavior of every small issue can be easily understood and incorporated to explain the behavior of entire gadget. This is the primary concept in the back of finite detail approach (FEM).

4. RESULTS

It is very difficult to sum up this type of work, which contain the large amount of values and graphs. So I decided to go with floor wise summary. This will help in better understanding of my work.

In this work 2 Building (G+5) are taken into consideration with 5 flooring. One is ordinary building and the alternative is with floating column. Mainly this work will focus on the building with floating columns. Under the static loading situation both the building are safe. In dynamic load; with floating column structure is discovered dangerous. i.e. In earthquake this building observed risky. The discern beneath display the normal building without floating columns bending second, shear pressure and axial force while the constructing is beneath any kind to loading condition.

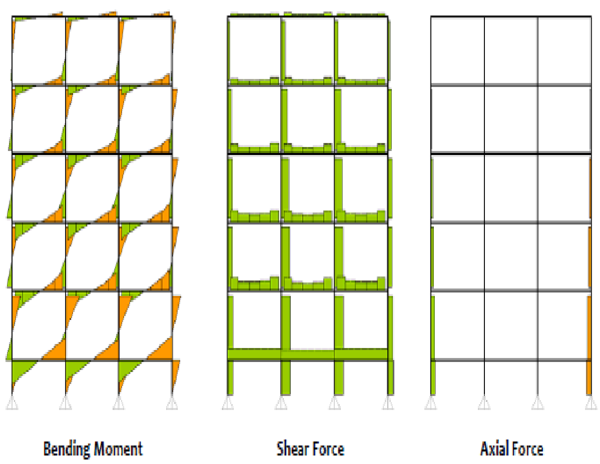

Figure Behaviour of moment frames: Bending moment, shear force and axial force diagrams in the benchmark building having moment frames

5. CONCLUSION

- Test model was built, with specified specification.
- Vibration sensor was developed to measure the vibration amplitude.
- CAD model was created with all specification of test model to match the desired condition.
- Simulated environment was developed with all the boundary condition.
- Compered the result of both simulation and experiment.
- Data analysis.
- Based on the test results, the following conclusions were made:
- By the application of lateral loads in X and Y direction at each floor, the displacements of floating column building in X and Y directions are less than the normal building but displacement of floating column building in Z direction is large compared to that of a normal building. So the floating column building is unsafe for construction when compared to a normal building.
- By the calculation of lateral stiffness at each floor for the buildings it is observed that floating column building will suffer extreme soft storey effect where normal building is free from soft storey effect. So the floating column building is unsafe.
- After the analysis of buildings, comparison of quantity of steel and concrete are calculated from which floating column building has 40% more rebar steel and 42% more concrete quantity than a normal building. So the floating column building is uneconomical to that of a normal building.
- From the time history analysis it is noticed that the floating column building is having more displacements than a normal building. So floating column building is unsafe than a normal building. The final conclusion is that do not prefer to construct floating column buildings.
- With increase in dimensions of all members also it is getting more displacements than a normal buildings and also the cost for construction also increased. So avoid constructing floating column buildings.
- Use of floating columns results in the increase in the bending moment, shear and Steel requirement.
- These floating columns are not suitable in the seismic zones in which load travel path will be disturbed due to earth quake and building may be damaged.
- The optimum position to provide floating column is at 2nd floor alternatively so that moment, shear and steel requirement of the whole building can be minimized.
- From the results it is observed that the building with floating column at Zone 2 and Zone 3 can be safe designed by increasing the dimensions of the beams and columns, whereas in Zone 4 and Zone 5 the Recommendations are ultimately to be followed in the design.
- Hence provision of floating column is advantageous in providing good floor space index but risky and vulnerability of the building increases.
- The natural time periods obtained from the

empirical expressions do not agree with the analytical natural periods. Hence, the dynamic analysis is to be carried out before analyzing these types of structures. And also it can be concluded from the analysis that the natural time period depends on the building configuration.

- Lateral displacement increases along the height of the building. There is more increase in the displacement for the floating column buildings compared with the regular building.
- The inter storey drift also increases as the increase in the number of storey's. The storey drift is more for the floating column buildings because as the columns are removed the mass gets increased hence the drift.
- As the mass and stiffness increases the base shear also increases. Therefore, the base shear is more for the floating column buildings compared to the conventional buildings.
- The recommendations such as shear walls, infill walls, bracings are considered in the modelling and analysis and observed that they can also be designed as an earthquake resistant up to an extent, such that on introduction of floating columns in the RC frames increases the time period of bare frames due to decrease in the stiffness.
- Hence, from the study it can be concluded that as far as possible, the floating columns are to be avoided especially, in the seismic prone areas. Generally, a building becomes expensive if it is designed to sustain any damage during a strong earthquake shaking. On comparison of the results obtained for each model, it is observed that the building with normal column building have lesser displacements and story drifts when compared with the floating column models. Similarly, when the floating column models are compared with each other, it is observed that the floating column building at one Edge column position have higher displacements and story drifts followed by floating column at parallel positions and finally the floating column at the centre portion.

- Finally, it is concluded that the floating column building, will lead to the increase in dimensions of the members in the structure to increase the stiffness and for the earthquake resistant design of the building with various recommendations considered which are more in cost comparing with a normal building cost of construction. But following sustainable measures and recommendations can even give an earthquake resistant design of the building with floating column building built even at the higher seismic zone.

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