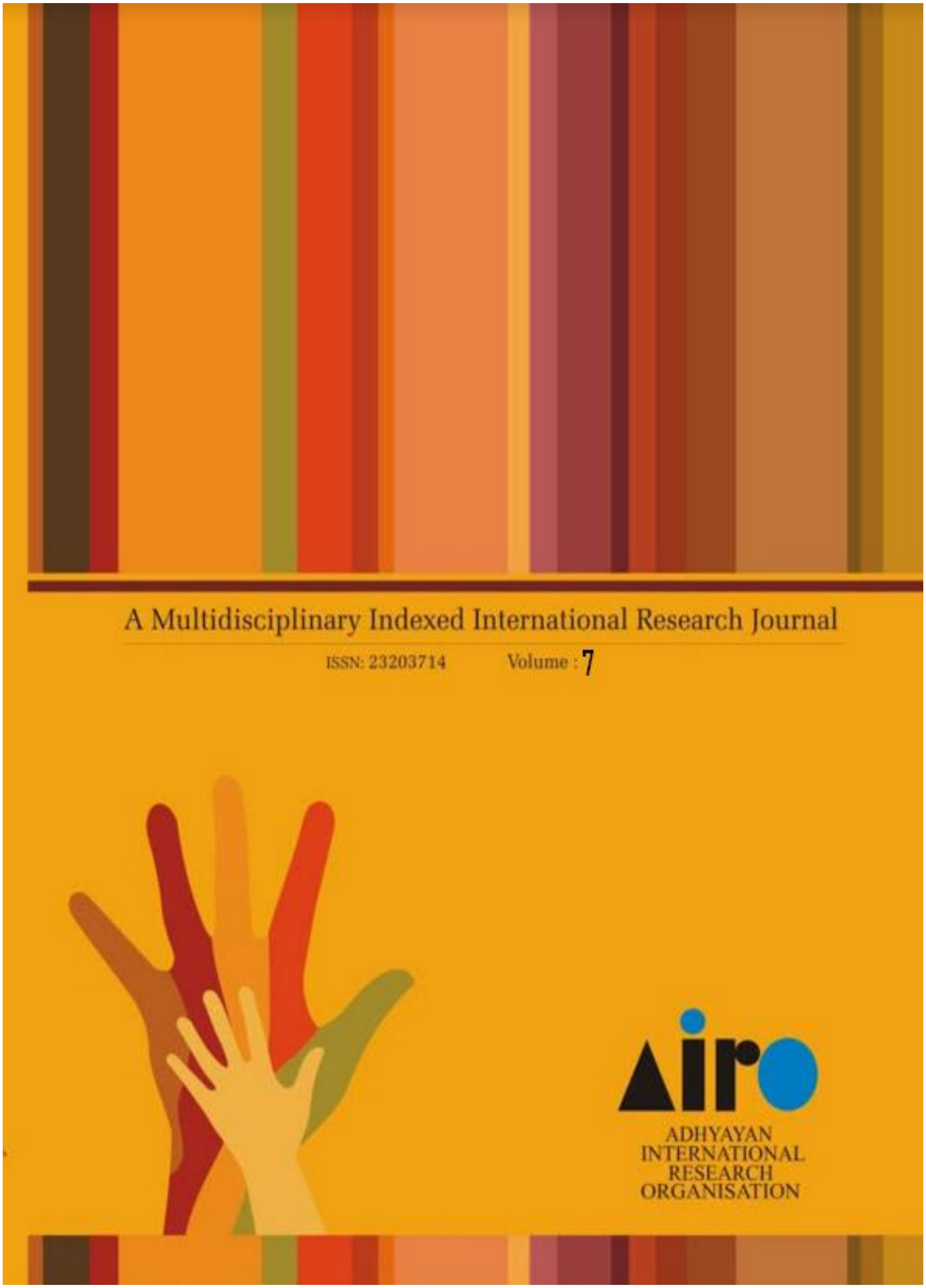
A Multidisciplinary Indexed International Research Journal
ISSN: 23203714 Volume : 7
ADHYAYAN
INTERNATIONAL
RESEARCH
ORGANISATION

Airo International Research Journal March, 2016
Volume VII, ISSN: 2320-3714

A REVIEWED STUDY REINFORCED CONCRETE STRUCTURE FOR EARTHQUAKE RESISTANT DESIGN

C. Sudharshan, Research Scholar, Department. of Civil Engg., Sunrise University, Alwar, Rajasthan
Dr. Asadi Siva Sankar, Supervisor, Department of Civil Engg., Sunrise University, Alwar, Rajasthan

Abstract

Earthquakes in various parts of the world showed the sad outcomes and powerlessness of lacking structures. Many reinforced concrete (RC) framed structures situated in zones of high seismicity in India are developed without considering the seismic codal arrangements. The weakness of insufficiently designed structures speaks to seismic risk to tenants. The primary driver of failure of multi-story multi-inlet reinforced concrete frames amid seismic movement is the delicate story influence instrument or column influence system. The seismic inertia forces produced at its floor levels are exchanged through the different beams and columns to the ground. The failure of a column can influence the strength of the entire building, yet the failure of a beam causes limited impact. In this way, it is smarter to make beams to be the ductile weak links than columns. This method of designing RC structures is known as the strong-column weak-beam design method.

On the off chance that the edge is designed on the premise of strong column-weak beam idea the potential outcomes of collapse because of influence instruments can be totally dispensed with. In multi story outline this can be accomplished by enabling the plastic pivots to frame, in a foreordained grouping just at the closures of the considerable number of beams while the columns remain basically in elastic stage and by staying away from shear method of failures in columns and beams. This technique for design is known as Capacity based design which would be the future design philosophy for earthquake resistant design of multi story multi straight reinforced concrete frames. The point of this undertaking work is to display a

comprehensive worked out example on 3 dimensional seismic analysis and capacity based design of five storied-three cove reinforced concrete casing.

INTRODUCTION

Civil engineering structures are for the most part designed to resist static loads. For the most part the impacts of dynamic loads following up on the structure are not considered. This component of dismissing the dynamic forces here and there turns into the reason for disaster, especially if there should be an occurrence of earthquake. The hate case of this classification is Bhuj earthquake occurred on Jan.26, 2001. This has made a developing interest and requirement for earthquake safe design of structures.

Conventional Civil Engineering structures are designed on the premise of strength and firmness criteria. The strength is Identified with extreme limit state, which guarantees that the forces created in the structure stay in elastic range. The firmness is identified with serviceability limit state which guarantees that the structural displacements stay inside the allowable limits. If there should be an occurrence of earthquake forces the demand is for ductility. Ductility is a basic attribute of a structure that must respond to strong ground motions. Ductility is the capacity of the structure to experience distortion or deformation without harm or disappointment which brings about dissipation of energy. Bigger is the limit of the structure to misshape plastically without collapse, more is the subsequent ductility and the energy dissipation. This causes reduction in successful earthquake forces.

The seismic inertia forces produced at its floor levels are exchanged through the different beams and columns to the ground. The right building components should be made ductile. The disappointment of a column can influence the soundness of the entire building; however the disappointment of a beam causes confined impact. In this way, it is smarter to make beams to be the ductile weak connections than columns. This method of designing RC buildings is known as the strong-column weak-beam design method.

The greater part of the energy created amid earthquake is disseminated by columns of the soft stories. In this procedure the plastic pivots are framed at the closures of columns, which change the soft story into an instrument. In such case the collapse is unavoidable. In this way, the soft stories merit a unique consideration in analysis and design.

CAPACITY BASED DESIGN

Capacity Design is a concept or a method of designing flexural capacities of critical part sections of a building structure based on a hypothetical behavior of the structure in responding to seismic actions. This hypothetical behavior is reflected by the assumptions that the seismic action is of a static equivalent nature increasing gradually until the structure reaches its state of near collapse and that plastic hinging happens simultaneously at predetermined locations to form a collapse mechanism simulating ductile behavior. The actual behavior of a building structure during a strong earthquake is far from that described above, with seismic actions having a vibratory character and plastic hinging occurring rather randomly. Be that as it may, by applying the Capacity Design concept in the design of the flexural members of the structure, it is believed that the structure will have adequate seismic resistance, as has been demonstrated in many strong earthquakes in the past.

A feature in the Capacity Design concept is the ductility level of the structure, communicated by the displacement ductility factor or briefly ductility factor. This is the ratio of the lateral displacement of the structure because of the Design Earthquake at near collapse and that at the point of first yielding.

The basic of capacity based design lies on strong column and weak beam concept. The seismic inertia forces generated at its floor levels are transferred through the various beams and columns to the ground. The right building parts should be made ductile. The failure of a column can affect the stability of the entire building, yet the failure of a beam causes localized impact. Therefore, it is smarter to make beams to be the ductile weak links than columns. This method of designing RC buildings is called the strong-column weak-beam design method.

Basic steps for capacity based design:

1. Design loads i.e. dead loads, live loads and earthquake loads are calculated.
2. Seismic analysis of the frame for all load combination specified in IS 1893 (Part I):2002 are finished.
3. Members are designed (according to IS 456:200) for maximum forces obtained from all load combinations. Beams are designed for maximum sagging and maximum hogging moments. Provided reinforcements are calculated following the standards given in code. Columns are designed for the combination for moment and corresponding axial force providing maximum interaction impact i.e. considering the eccentricity.
4. The flexural capacities of the beams under sagging and hogging condition for the provided reinforcements are calculated.
5. The flexural capacity of columns at a joint is compared with actual flexural capacity of joining beams. If the sum of capacities of columns is not as much as the sum of capacities of beams multiplied by over strength factor, the column moments ought to be magnified by the factor (moment magnification factor) by which they are lacking in moment capacity over beams. If the sum of the column moments is greater than sum of beam moments, there is no compelling reason to magnify the column moments.
6. Columns are designed for the revised moments and the axial force coming on it from the analysis.
7. Shear capacity of beams are calculated on the basis or their actual moment capacities and shear reinforcements are calculated.
8. Similarly shear capacity of column is calculated on the basis of magnified moment capacities. Then the columns are designed for shear.

STEP-BY-STEP PROCEDURE FOR CAPACITY BASED DESIGN:

Step 1: Seismic Analysis of Frame (G+3)

Seismic analysis of the plane frame is carried out with all load combinations according to IS 1893 (Part 1); 2002. The maximum interaction impact for columns and maximum force for beams from all load combinations for each part is considered for design. Design forces in columns and beams are exhibited in Figures 7 and 8. In capacity based design, beams are designed similar to normal design procedure for the calculated forces by the linear elastic analysis for different load combinations. Figure below demonstrates the actual amount of longitudinal reinforcement in the beams.

The design forces of columns are not totally based on linear elastic analysis rather they depend upon the actual flexural capacities of the beams framing into the same joint. With the goal that plastic hinges may not form at the base of column above and at the highest point of the column below the joint.

Step 2: Determination of Flexural Capacity of Beam

The flexural capacities of the beams under hogging and sagging conditions for the provided reinforcement are calculated.

Step 3: Establishing a strong Column-weak Beam mechanism

To eliminate the possibility of a column sway mechanism (soft story) during the earthquake, it is essential that the plastic hinges ought to be formed in beams (with the exception of at the base of the columns of ground story). This condition can be achieved after moment capacity verification of columns with beams at each joint of the frame with the formation of beam mechanism as it were. The amount by which the design moments of columns at a joint to be magnified, is achieved by determination of the moment magnification factor at that particular joint.

Step 4: Determination of Moment Magnification Factors for Columns

The moment capacities of columns are to be checked for the sum of the moment capacities of beams at the joint with an over strength factor of 1.4. If the "sum of capacities of columns" is not exactly the "sum of moment capacities of beams multiplied by over strength factor", the column moments ought to be magnified by the factor by which they are lacking in moment capacity over beams. If the sum of column moments is greater than sum of beam moments, there is no compelling reason to magnify the column moments. In such cases the multiplying factor is taken as unity. After obtaining the instigate magnification factors, the column flexural strengths are to be increased accordingly at each joint and the maximum revised moment from the best and base joints to be taken for design.

Step 5: Capacity Design for Shear in Beams

The design shear forces in beams are corresponding to the equilibrium condition of the beam under the appropriate gravity load (permanent dead load + % of live load) and to end resisting moments corresponding to the actual reinforcement provided, further multiplied by a factor γ_{Rd} (Figure below). This γ_{Rd} factor compensates the partial safety factor γ_s applied to yield strength of steel and to account the strain hardening effects. In the absence of more reliable data, γ_{Rd} may be taken as 1.4

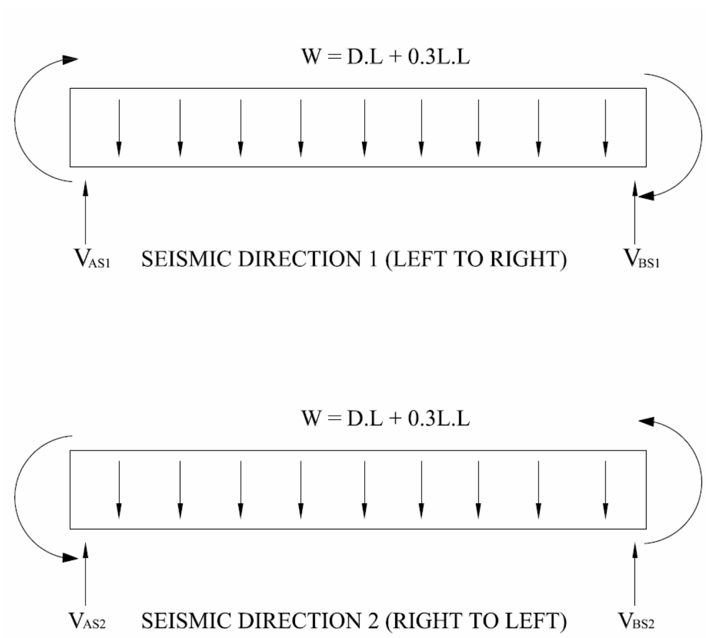

Figure-1 Equilibrium condition for the determination of shear force

CONCLUSION

1. Capacity based earthquake resistant design is modern way to deal with design of reinforced concrete structures particularly for multi-bay multi storied reinforced concrete buildings.
2. This idea is to limit the arrangement of plastic hinges in the beams just subsequently
3. collapse happens through the shaft mechanism just, which confine the failure and consequently prompts less destruction and loss of lives.
4. Collapse because of sway mechanism can cause failure of a story or entire frame. As its approach is to dispense with sway mechanism by making columns more grounded than beams, this strategy is extremely compelling in design of soft-story frames.
5. This strategy additionally disposes of the likelihood of shear mode of failure (which is weak by nature consequently failure happens all of a sudden) by making shear capacity of elements more than their moment capacity.
6. Contrasted and the conventional design methods for earthquake resisting structures in spite of the fact that this technique is minimal costlier however is more successful in resisting the earthquake forces.

REFERENCES

1. Achyutha H, Injaganeri S.S, Sathyanarayanan S and Krishnamoorthy C.S.,‘ Inelastic behaviour of brick infilled reinforced concrete frames’, *Journal of Structural Engineering* ,Vol.21,No.2,pp 107-115,July 1994.

2. Amar A. Chaker and Arslan Cherifati., ‘Influence of masonry infill Panels on the vibration and stiffness characteristics of R/C frame buildings.’ *Earthquake Engineering and Structural Dynamics*, Dyn.28, pp1061-1065, 1999.

3. Amar Prakash and S. K. Thakkar., ‘A Comparative study of Retrofitting of RC building using Steel bracing and Infill Walls.’ *Workshop on Retrofitting of Structures*, Oct, 10-11, 2003, pp159-173, IIT Roorkee.

4. Armin B. Mehrabi, Bension Shing P, Michael P. Sculler and James L. Noland (1996)., 'Experimental Evaluation of Masonry-infilled RC frames.' *Journal of Structural Engineering*, vol.122 No.3, pp 228-237.

5. Armin B.Mehrabi, P.Benson Shing.,'Finite element modeling of Masonry-infilled RC frames.' *Journal of Structural Engineering* ,Vol.123, No.5, pp84-93,ASCE,May1997.

6. Asteris P.G., 'Lateral Stiffness of brick Masonry infilled plane frames.' *Journal of Structural Engineering*, ASCE ,pp 1071-1079,Aug 2003.

7. Benjamin J. R and Williams H.A., 'The behaviour of one storey reinforced concrete shear walls.' *Journal of Structural Division*, ASCE, Vol.84, ST-4, July 1958, pp 605.

8. Benjamin J.R and Williams H.A., 'The behaviour of one storey walls containing openings.' *Journal of American Concrete Institute*, Vol.30.Nov. 1958.

9. Bhandari N.M and Trikka D.N (1998)., 'Analysis of masonry buildings using

10. proposed super masonry element.' *Masonry International*, Vol.2 No.1 June 1998.

11. Brian Stafford Smith., 'Behaviour of Square infilled frames.' *Journal of the Structural Division*, Proceedings of ASCE, 1966, Vol. 92, pp380-403.

12. Dawe J.L, Liu Y and, Seah C.K., 'A computer model for predicting infilled R.C. frame behaviour', Canadian *Journal of Civil Engineering*, Vol.28, pp133-148, 2001.

13. Dhanashekar M and Page A.W (1986)., 'Influence of brick masonry infill properties on the behaviour of infilled frames.' *Proceedings of Institution of the Civil Engineers*, Part2, pp 593-605, 1986.

14. Fajfar P & Fischinger M (1990).,

'Mathematical modeling of Reinforced concrete structural walls for nonlinear seismic analysis.' *Proceedings of European Conference on Structural Dynamics*, EURODYN'90,5-7,June 1990,Bochum,FR Germany ,vol.1,PP 471-479.

15. FEMA 273, (1997)., NEHRP guide lines for the seismic rehabilitation of buildings, *Applied Technology Council*, USA.

16. Francisco J. Crisafulli, Athol J. Carr and Robert Park., 'Analytical modeling of Infilled frame Structures-A general Review.' *Bulletin of the New Zealand society for Earthquake Engineering*, Vol.33, No.1, March 2000, pp404-413.