DYNAMIC ANALYSIS OF A SINGLE STOREY REINFORCED CONCRETE STRUCTURAL MODEL IN AGGRESSIVE ENVIRONMENT

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Abstract: **The main aim of this paper is to dynamically analyze a single storey model RCC structure. The basic parameters involved in this analysis are load carrying capacity, ductility and stiffness. on the other side response parameters like shear, bending moments, displacements etc. are calculated. Beams and frames are mainly proposed in this formulation however we can extend it to other types of structures too. The parameters are calculated with the minimum requirement of criteria as per IS 456:2000. For dynamic analysis of the model time history method or response spectra method as well as cellular automata approach is used. The effectiveness of the two used methodologies (response spectra method and cellular automata approach) in handling the complex reinforced cement concrete structure modeled as structural systems which are further modeled as two-dimensional or three-dimensional frame systems using finite beam elements.**

Index terms: **durability, dynamic loading, reinforced concrete (RC).**

I. INTRODUCTION

Structural design of reinforced concrete (RC) structures in adverse environments and under different loading conditions is most commonly concerned with securing the potential of the concrete to resist the penetration of aggressive agents during its intended service life. Firstly, the motive of all types of structural systems used in building structures is to transfer gravity loads efficiently and effectively. The major combination of loads resulting from the gravity is dead load and live load. Besides vertical loads, structures also withstand transverse loads caused by earthquake or wind. Generally, Lateral loads results in sway movement, high stresses or may cause vibrations. Therefore, it becomes quite important for the structures to have desirable strength against vertical loads along with lateral forces.

The durability analysis of the model reinforced structure are based on two methodologies as, response spectra method or time history method and cellular automata approach also pushover analysis is also taken under consideration.

Time history method: provides for linear and non-linear evaluation of dynamic structural response under loading.
Cellular automata approach: novel approach to the problems related to durability analysis and lifespan assessment of concrete structure under the attack of diffusion from external aggressive agents. Response spectrum analysis: can be used to estimate the structural response to short, non-deterministic, transient dynamic events.

The paper contains the following sections: in Section II, the literature survey is covered and it tells the approaches and technologies used by various researchers. Section III, defines our approach it shows the Structural modeling part of the proposed model and Section IV shows various test results which were obtained during the whole analysis. Section V includes conclusion.

II. LITERATURE SURVEY

Ulam and Von Neumann in 1948-50 (VON NEUMANN 1966) introduced the concept of cellular automata and later on it was furthermore advanced by some more analyst in many other area of discipline. Originally the concept was related with the analysis of self-replicating complications on the Turing's machine. Basically, they are the simple representation of arithmetic apotheosization of physical arrangement in which the two dimensions (time and space) are considered as distinct, and the physical arrangement are taken from a restricted set of distinct utilities. Properly speaking, approaches depending on cellular automata supply a different perspective and additional generalized method instead of a conjecture; they depict a composite conduct comparable to related with composite differential equations, though in the following case the convolution arrives from the inter-activity of uninvolved operations that follows simple dominion.

Dj. Ladjinovic et al. (2012) carried out by an audit of exemplar approaches of the examination achieved for the outlined technique of reinforced concrete encase using the software. This review paper depicts unlike prospects for modeling plastic hinges for nonlinear static examination of R.C.C. enclosure. The existent conduct of the modeled structure in course of an environmental change could be the pre-eminent braced using the nonlinear dynamic time history analysis (THA). The robustness and distortion capability of ductile reinforced concrete constituent of the reinforced concrete encased model is done by the examination of moment-curvature depending on the embraced or considered properties of the materials. Nonlinear conduct of constructional components is apotheosized by plastic hinges set in the positions that have already been selected. Since, THA is yet so complex for feasible uses; the observation procedures depending on nonlinear static pushover methods is taken in consideration.

Mohammed yousuf, P.M. shimpale (2013) carried out the durability examination of R.C.C. model which had asymmetry in plan. The FE based software was used for the analysis of R.C.C. building. The approximation of forces like; lateral forces, storey drift, base shear, are implemented. For studying effectiveness in resisting lateral forces four cross sectional variation in columns were considered. The effect due to changes of the model plan on the constructional behavior of model are also dealt with in this paper.

D. Baldev Prajapati (2013), audited about the inspection & outline methods that may be carried out for the examination of regular R.C.C. model. The structures are modeled to withstand the moderate and customarily taking place environmental changes and should have adequate stiffness and bearing capacity to restrict the displacement and to avoid damage in any manner. This is unsuitable to outline a frame to persist under elastic region, under aggressive environmental changes, because of the economic restrictions.

Kanhaiya K. Tulani and Pralobh S. Gaikwad (2014), the review paper's main objective is the durability analysis of reinforced concrete model with unregular design. For the purpose of analysis of models under R.C.C. building with unregular plan is consider. The examination is implemented by using F E dependent software's. different aspects such as transverse force, story drift, shear, story moments could be resolved. For durability examination response spectra method or time history method is taken under consideration. If R.C.C. building are unregular and the effect of torsion will be occurring in the model and yet they can be used to evaluate the efficient model under the response of torsion effect.

Hugo Batchmann et al. audited a nonlinear dynamic examination procedure for the reinforced building under severe environmental action. Non-linear variables for designing of plastic hinge in beams as well as columns are provided in the following paper.

A.S. Elnashai and A.M. Mwafy, In this review paper has provided the appropriateness and exactness of nonelastic static pushover examination in forecasting the environmental retaliation of R.C.C. model is looked upon. The durability pushover idealized cover is attained from marginal durability subside examination.

Mayuri D. Bhagwat et al., (2014), did durability examination of observed R.C.C. model by carrying out the response spectrum analysis and time history analysis of reinforced concrete building and analogously studied and modeled.

C Prabha and Romy Mohan, deliberated two reinforced concrete building, the paper dealt under the upshot of the disparity of the length of the buildings on the constructional retaliation of shear. This review paper culminates the accurate and exactness of the Time History examination and response spectrum examination in juxtaposition with the highly often embraced Equivalent Static examination.

A.S. Patil, studied the nonlinear durability examination of R.C.C. building considering different retaliation corresponding to shear, moments, displacements of such building. The structure under going deliberation is hewed with the aid of software's. The software's are skilled enough to forecast the nonlinear conduct of different dimensions of space frames under static as well as dynamic loadings.

III. MODELING AND ANALYSIS

The analysis is done using the software finite element for the purpose of creating the 3 dimensional model to carry out the examination. This software can forecast geometric non-linear conduct of space enclosures under the effect of dynamic or static loadings, considering the two geometric non-linearity and inelasticity of material. In following review paper, a non-linear response spectrum examination is to be done on a single storey R.C.C. model taking into account the response spectrum from the cellular automata approach. This software considers static loads (considering forces, moments and displacements) and also dynamic responses ans is skilled to execute non-linear static, dynamic and eigen values analysis. The model considered for examination has been adopted for study is a single storey model. This model consisting rectangular columns of measurements 45mm X 30mm, the beams with measurements 40mm X 60mm. The depth of footing is taken as 28mm thick and the height of the floor is taken as 80mm.

The PLAN of the model is shown in below figure using AUTOCAD drawings.

It consists of 11 columns and the size of each column is 45mm x 30mm.

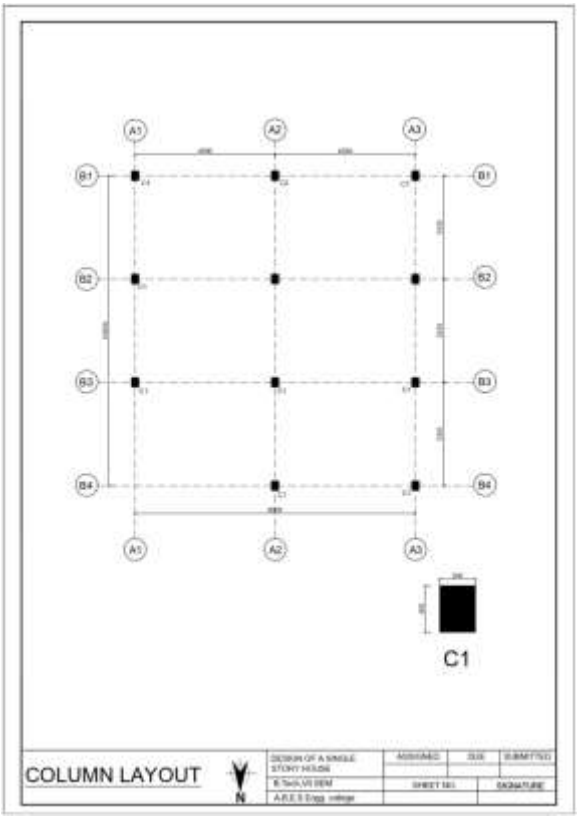

fig 1: Column Layout

The 3D rendered view of the model is shown below using STAAD PRO. The structure is an unsymmetrical framed structure consisting of beams and columns as the main load bearing members.

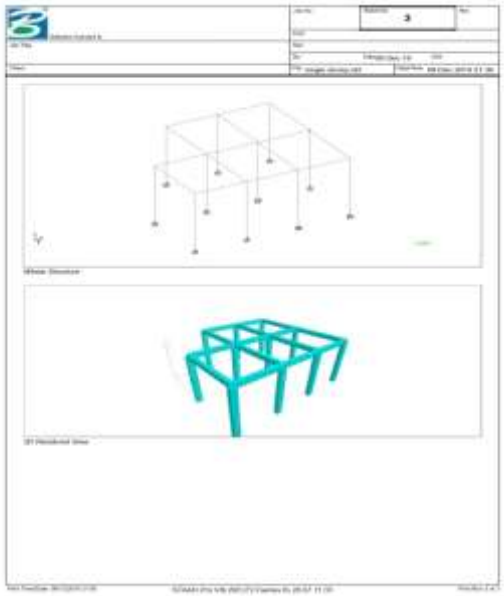

fig 2: 3D Model

IV. ANALYSIS RESULTS

A. Juxtaposition among response spectrum method and equivalent static method :

With the references it is observed that for the seismic examination equivalent static method is used as a non-linear static method. The following fig.3 represents the graph between the response spectrum and equivalent static method we have also concluded that the response spectrum method is linear in nature.

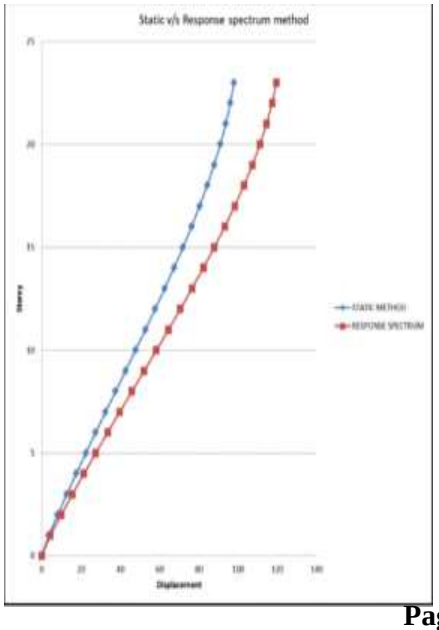

fig 3: Static v/s Response Spectrum method

B. Stress distribution of the model using STAAD PRO :

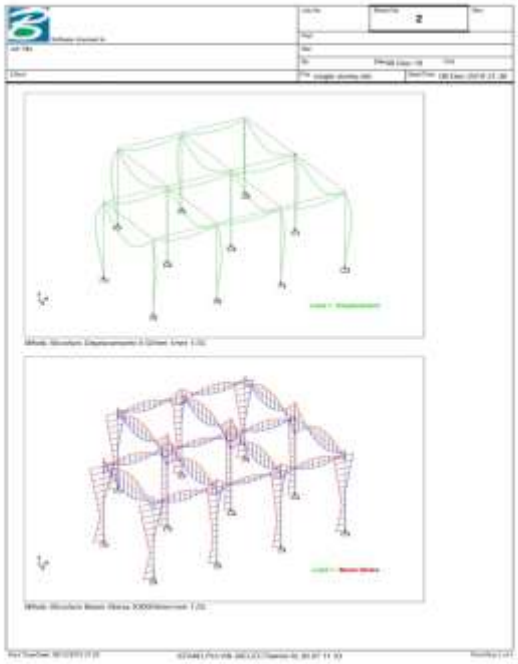

fig 4: Stress Distribution of the model

C. Dynamic examination of a R.C.C. Structure:

For the welfare of R.C.C. structures that are disclosed to aggressive conditions are required to be examined time to time using durability analysis that can account for diffusion process as well as mechanical damage. The coupling effect between the three (damage, diffusion and structural behavior) is observed. The reference is taken from cellular automata approach that mainly aims at the time variant non-linear examination of R.C.C. framed structures and the results are then applied to the model under examination.

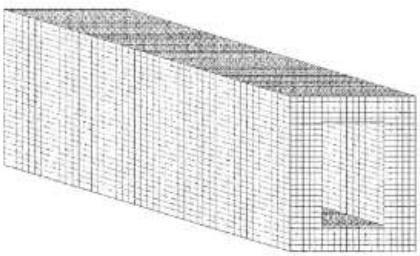

fig 5: a grid (cellular approach) is used for numeric integration for columns and beam elements with the cross section as rectangular.

D. Mechanical damage modelling is done as:

The damaging factor in R.C.C. under diffusion is quite complex. Furthermore, the corresponding information provided in reference review paper is about environmental negotiators. however, it is observed that the material characteristics is generally not adequate for contingent modeling. Despite of having complexities a simple degradation model is successfully accepted.

$A_c = A_c\, t$ and the steel bars $A_s = A_s\, t$

$$dA_c\, t = 1 - {}_c\, t\, dA_{c0}$$

$$dA_{s\ t = 1 - s\ t\ dAs0\ 9}$$

In the study of this review paper it is observed that indexes are corresponded to the diffusion prosses by presuming all the materials a relationship among the concentration and damage rate is observed in the aggressive environment.

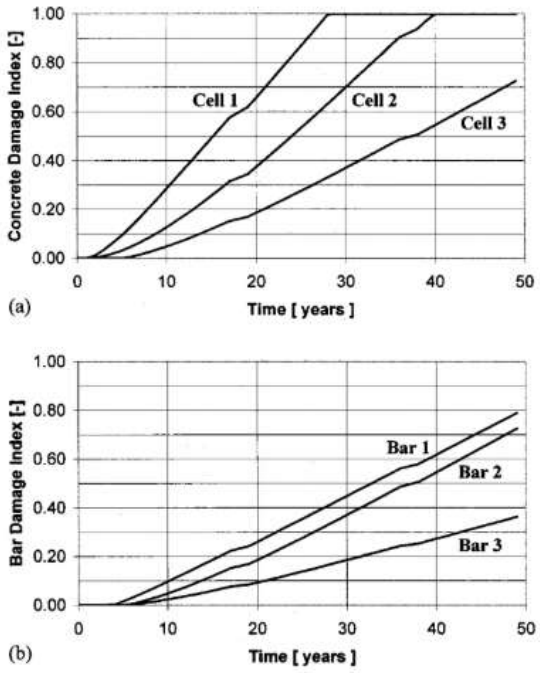

fig 6: damage index of time history analysis (I)graph showing three different concrete cells (II) graph showing three different steel bars.

V. CONCLUSION

This paper introduces a new approach for solving the problem of harm caused to the reinforced concrete structures in aggressive environment. Dynamic analysis of reinforced concrete structures under the effect of aggressive environmental agents is in general examined through the study of local deterioration and destruction of the materials. The approaches used in this paper have the objective of

overcoming the previous backwards. The main novelity of the following approaches is the use of a special class of revolutionary algorithms and various techniques to investigate the harmful deterioration processes. The work depicts the importance of accounting for the high variability that are present in basic variables for durability design.

VI. REFERENCES

[1] D. Baldev Prajapati & D.R. Panchal study of wind effect and seismic effect on r.c.c. building.

[2] P. D. Kumbhar & A S Patil made time history examination of r.c.c. buildings.

[3]A. Raseta, Dj. Ladjinovic ,A. Radujkovic & R. Folic- analysed Comparison between Structural Models Storey Frame Buildings along with seismic Design of R.C.C. Buildings.

[4] Dr. P.S. Patil and D. Mayuri Bhagwat made Comparative study on performance of R.C.C. building for koyna as well as bhurj earthquakes.

[5] Bijen, J. (1996-1997) worked on Blast furnace slag cement (Den Haag CIP Royal Library).

[6] Duracrete (2001) Statistical Quantification of the Variables in the Limit State Functions, The European Union—Brite EuRam III, Project BE95-1347/R9, Probabilistic Performance-Based Durability Design of Concrete Structures.

[7]EN1990(2000)Eurocode:basisofstructuraldesign.British Standards Institution.

[8] RavikumarG.andKalyanaraman, ―Seismic design and retrofit of RC multistoried buildings with steel bracing‖, National Program on Earthquake Engineering Education, 2005.

[9] Ferraioli, M., Avossa, ―Performance based assessment of R.C. buildings strengthened with steel braces‖, Proceedings of the 2 nd International Congress Naples, Italy, 2006.

[10] Romy Mohan, C Prabha "Dynamic Analysis of RCC Buildings with Shear Wall", IJESE, Vol. 4(6), pp- 659662, 2011.

[12] Chopra A. K, Dynamics of structures theory and applications to earthquake engineering, Prentice- Hall, Englewood Cliffs, N.J. 1995.

[13] IS: 1893 (Part 1) 2002- Indian standard- "Criteria for earthquake resistant design of structures", Bureau of Indian Standards, New Delhi.

[14] A.R. Chandrasekaran, D. S. Prakash Rao, "Aseismic Design of Multi-storied RCC Buildings,"

[15] D Mayuri, D. Bhagwat,P.S.Patil, "Comparative study of performance of rcc multistory building for koyna and bhuj earthquakes," .

[16] R. K. Bajpai, S. Sharma and M.K. Gupta, "Dynamic analysis on Multistory R.C.C. Framed structures with the help of different software,".

[17] M. Yousuf, P.M. shimpale, "Dynamic Analysis of Reinforced Concrete Building with Plan Irregularities