Investigation of Steel Building for Analysis of Seismic Performance

Sanjio D. Gajbhiye[1], Sanjay K. Bhadke[2]
[1]M-Tech Research Scholar (Structure), Civil Engineering Department, Tulsiramji Gaikwad-Patil College of Engineering and Technology, Mohgaon, Nagpur, MH.
[2]Asst. Professor, Civil Engineering Department, Tulsiramji Gaikwad-Patil College of Engineering and Technology, Mohgaon, Nagpur, MH.

Abstract:

Seismic analysis is a non-linear static procedure that uses a simplified non-linear technique to estimate seismic structural deformations. It is an incremental static analysis that is used to determine the force-displacement relation or the capacity curve for a structure or a structural element. The analysis involves applying horizontal loads, in a prescribed model, to the structure incrementally, that is, pushing the structure and tracing the total applied cutting force and the associated lateral displacement in each increment, up to the condition of structure or collapse. In art, a computer model of the building is subject to a lateral load of some form (ie inverted or uniform triangular). The intensity of the lateral load increases slowly and the sequence of cracks, the performances, the formation of the plastic hinge and the failure of various structural components are recorded. Seismic analysis can provide a meaningful understanding of weak links in the seismic performance of a structure. Performance criteria for seismic analysis are generally set as the desired state of the building, given the range of movement of the roof or spectrum.

The seismic response of the RC building frame in terms of performance point and the effect of seismic forces on multi-storey construction structures with the help of seismic analysis is done in this document. In the present study, a frame of the building is designed according to the Indian standard, e.g. IS 456: 2000 and IS 1893: 2002. The main objective of this study is to verify the type of performance a building can give when designed according to Indian standards. Seismic analysis of the building frame is performed using structural analysis and SAP 2000 design software.

Keywords: **Seismic Analysis, Nonlinear Static analysis, Performance point, Capacity curve.**

I. INTRODUTION

Seismic analysis is a method of approximate analysis in which the structure is subjected to lateral forces that increase monotonously with an invariable height distribution until an objective displacement is achieved. The seismic analysis consists of a series of sequential elastic analyzes, superimposed to approximate a force-displacement curve of the general structure. First, a two- or three-dimensional model is created that includes bilinear or load deflection diagrams of all the lateral force elements, and gravity loads are initially applied. Then a predefined lateral load pattern is applied, distributed along the height of the building. The lateral forces increase until some members fail. The structural model is modified to take into account the reduced rigidity of the assigned elements and the lateral forces are increased again until the additional elements are executed. The process continues until a shift of control at the top of the building reaches a certain level of deformation or the structure becomes unstable. The displacement of the roof is traced by cutting the base to obtain the global capacity curve.

Seismic analysis can be performed as controlled by force or displacement. In the force-controlled thrust procedure, the full-load combination is applied as specified, which means that the force-controlled procedure must be used when the load is known. In addition, in the seismic procedure controlled by some force Numerical problems affecting the accuracy of results occur because lens shift can be associated with very small or even negative lateral stiffness due to the development of P-delta mechanisms and effects.

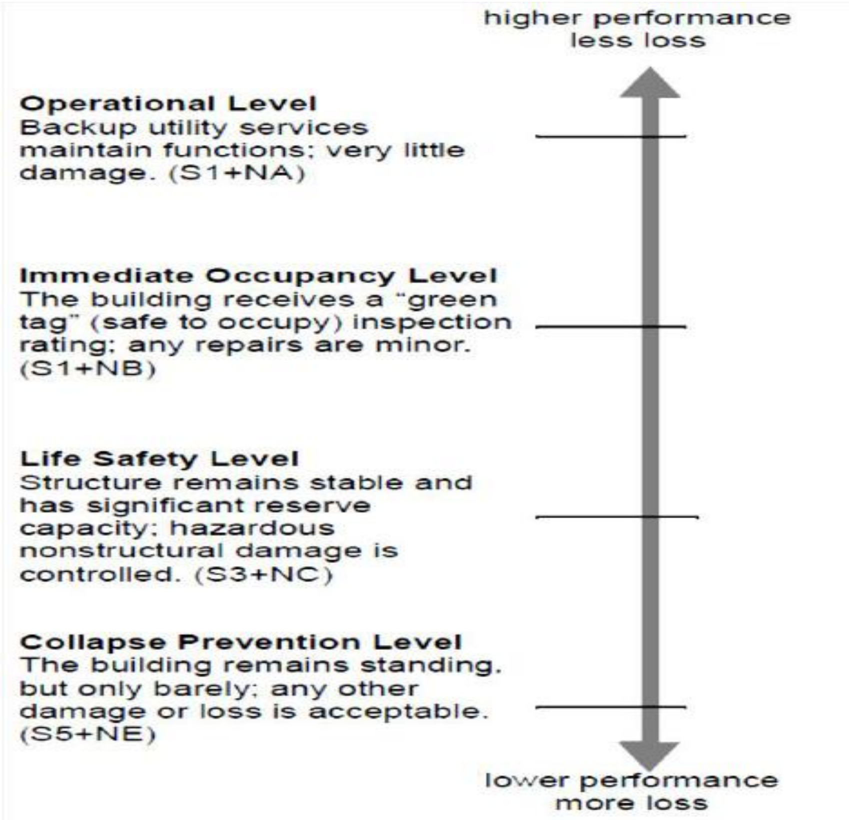

Fig. 1 Building Performance Levels (ATC, 1997a)

1.1. Objectives:

The primary objectives of this project can be summarized as follows:

- To investigate the seismic performance of a steel building with different arrangements.
- To evaluate the performance factors for steel building with various arrangements according to Indian Code.

II. LITERATURE REVIEW

Yousuf Dinar[1] Structures in large cities are seriously threatened by the design and construction of defective and non-faulty structures. Sometimes, structural designers are more concerned with building several load-resistant members without knowing their needs and performance in the structure. The different configuration of the construction can also entail a significant variation in the capacity of the structure itself. Nonlinear static seismic analysis provides a better understanding of the performance of structures during seismic events. This exhaustive survey evaluates and compares the yields of different levels of fill percentage, different configurations of soft floors and coherent cutting walls, and therefore, depending on the results, suggests from what level of performance the wall should be preferred to cut. on the filling structure and eventually it will help the engineers to decide where the soft floor in the structures could generally be built. Above all, on the basis of the results, one could summarize a better effect of seismic analysis. The masonry walls are represented by equivalent uprights according to the seismic codes of interest. For different load conditions, the performance of the structures is evaluated with the help of the point of performance, the cutting of the base, the upper displacement, the drift of the floor and the phases of the number of hinges.

C.-M. Chan[2] Performance-based design that uses nonlinear seismic analysis, which generally requires a tedious and intense computational effort, is a highly iterative process necessary to meet the requirements of the code and specified by the designer. This paper presents an effective computerized technique that incorporates seismic analysis along with numerical optimization procedures to automate the design of seismic drift performance of reinforced concrete (RC) buildings. The steel reinforcement, compared to concrete materials, seems to be the most economical material that can be used effectively to control the drift beyond the occurrence of the first performance and to provide the required ductility of the construction structures. RC. In this study, steel reinforcement relationships are taken as design variables during the project optimization process.

Sreedhar Kalavagunta[3] the progressive collapse of cold shelving structures formed subject to seismic load, using seismic analysis. A cold-formed steel structure of a simple storage frame with a non-linear static procedure according to FEMA 356 specifications was analyzed and the progressive collapse was recorded, such as employment, immediate occupation, safety of life and safety. collapse prevention. Seismic analysis was found to be a useful analytical tool for conventional rack storage systems that offer good estimates of general displacement needs, basic shears, and forming of plastic hinges.

Mehdi Poursha[4] the non-linear static procedure (NSP), based on seismic analysis, has become a preferred tool to be used in practical applications for building evaluation and project verification. However, the NSP is limited to the single-mode response. Therefore, it is valid for low buildings where the behavior is dominated by the fundamental vibration mode. It is known that the seismic demands derived from the conventional NSP are strongly underestimated in the upper floors of tall buildings, where contributions are important in a way superior to the response. This article presents a new seismic procedure that can take into account the effects in a superior way. The procedure, which has been called sequential seismic sequential procedure (CMP), uses seismic analysis of several phases and a single stage. The final structural responses are determined by wrapping the results of the multistage and single-stage seismic analysis.

Erol Kalkan[5] an essential and critical component of the evolution of performance-based design methodologies is the accurate estimation of seismic demand parameters. Non-linear static procedures (NSPs) are now widely used in engineering practice to predict seismic demands on building structures. While seismic demands using NSP can be calculated directly from a site-specific risk spectrum, nonlinear time-history analyzes (NTHs) require a set of terrestrial movements and an associated probabilistic assessment to account for random variability in the recordings of earthquakes. Despite this advantage, the simplified versions of NSP based on invariant load models such as those recommended in ATC-40 and FEMA-356 have well documented limits in terms of the inability to account for the higher effects and resulting modal changes in anelastic behavior. As a result, a series of improved seismic procedures have been proposed that overcome many of these drawbacks.

D.N. Shinde[6] Performance-based design that uses nonlinear seismic analysis, which generally requires a tedious and intense computational effort, is a highly iterative process necessary to meet the requirements of the code and specified by the designer. This paper presents an effective computerized technique that incorporates seismic analysis along with numerical optimization procedures to automate the design of seismic drift performance of reinforced concrete (RC) buildings. The steel reinforcement, compared to concrete materials, seems to be the most economical material that can be used effectively to control the drift beyond the occurrence of the first performance and to provide the required ductility of the construction structures. RC. In this study, steel reinforcement relationships are taken as design variables during the project optimization process.

Sashi K. Kunnath[7] Nonlinear Static Procedures (NSPs) are finding widespread use in performance-based seismic design, as they provide professionals with a relatively simple approach to estimating inelastic structural response measures. However, conventional NSPs using recommended lateral load models in FEMA-356 do not adequately represent the effects of changes in dynamic characteristics during anelastic response or the influence of higher modes. To overcome these drawbacks, some researchers have recently proposed some improved procedures. This article analyzes a method of modal combinations (MMC) that implicitly explains the effects in a higher way. MMC is based on invariant force distributions formed by the factored combination of independent modal contributions. The validity of the procedure is validated by comparing the response quantities, such as the drift between the plans and the ductility requests of the members using other seismic methods and also the results of the analysis of non-linear time history. Validation studies are based on the evaluation of three steel-structure buildings: two of these structures were instrumented during the Northridge earthquake, which provided realistic support movements for the temporal history predictions. Research findings indicate that the method of modal combinations provides a basis for estimating potential contributions of the highest ways in determining drift requests between plans and requests for local components in multi-storey buildings subject to seismic loads.

III. RESEARCH METHODOLOGY

The proposed work is planned to be carried out in the following manner

- Seismic behavior of steel building with various loads.
- Model the selected in seismic behavior of steel building with various loads.
- Linear seismic analysis of selected steel building.
- Design of steel building using SAP2000.
- Study of Seismic analysis.
- Carry out Seismic analysis of seismic behavior of steel building using SAP2000.

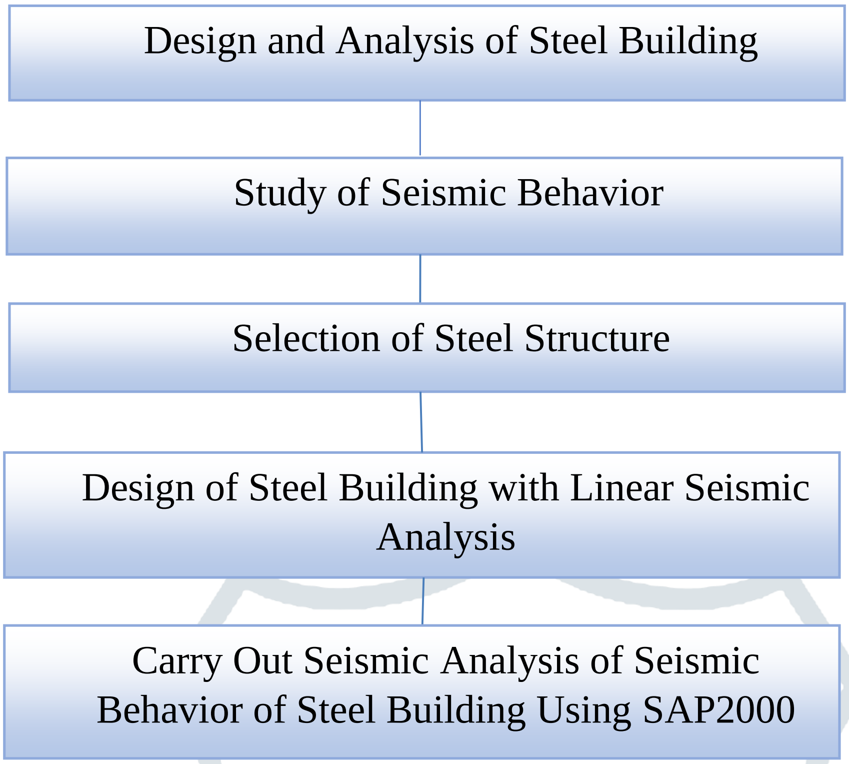

Fig. 2

IV. PROBLEM FORMULATION

The material (like steel) and the new structural shapes are being studied. Furthermore, it would be interesting to investigate further to further reduce bankruptcies. Some circumstances may lead to an unsafe seismic design. The data in the table is grouped according to the number of members of the table, the number of cards, the number of degrees of freedom, the restriction conditions and the elastic properties of the members. On this basis, the data is stored and the properties of the member section are calculated. The total joint stiffness matrix is obtained on the basis of the data of the previous table adding single stiffness matrices considering all the possible displacements. The load vector is then generated based on the load data and the unknown displacements are obtained by inverting the stiffness matrix of the general joint and multiplying the load vector.

V. SEISMIC ANALYSIS PROCEDURE

Pushover analysis can be performed as either force-controlled or displacement controlled depending on the physical nature of the load and the behavior expected from the structure. Force-controlled option is useful when the load is known (such as gravity loading) and the structure is expected to be able to support the load.

A displacement-controlled pushover analysis is basically composed of the following steps:

- A two- or three-dimensional model that represents the overall structural behavior is created.
- Bilinear or tri-linear load-deformation diagrams of all-important members that affect lateral response are defined.
- Gravity loads composed of dead loads and a specified portion of live loads are applied to the structural model initially.

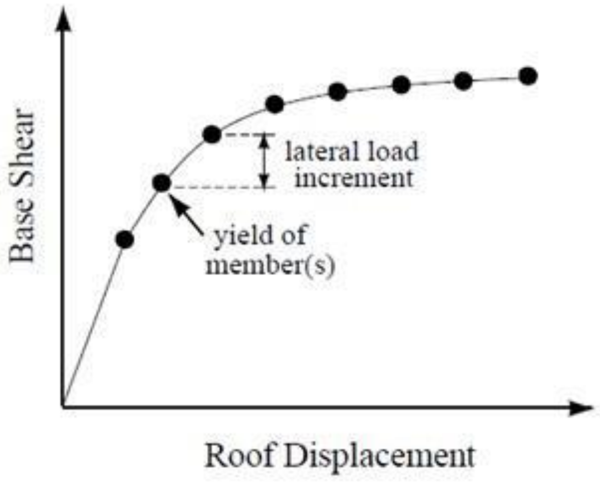

Figure 3: Global Capacity (Seismic) Curve of Structure

VI. CONCLUSION

1. The summary of the results leads to the decision that the configuration of filling, cutting wall and soft floor significantly affects the performance of rigid joint structures.

2. In the performance-based analysis, which is the seismic, the increase in filler increases the overall performance, while the cutting wall has maximum resistance against any lateral load.

3. Comparing the performance of all soft floor cases under transfer analysis, it was found that sending soft floors on each floor up or down has significant effects.

4. The conventional seismic analysis also shows gaps and limitations that limit its scope and raise doubts about its effectiveness in the accurate estimation of structural seismic demand.

5. To take into account the effects of the higher mode in the seismic analysis to predict the seismic demands of the structures of tall buildings, a consecutive modal shift procedure has recently been proposed.

6. The procedure uses some seismic analyzes. In CMP, modal thrust analysis is performed consecutively with force distributions using forms derived from the analysis of the linearly elastic structure.

7. In addition, a separate seismic analysis is performed using a uniform or triangular load distribution. The seismic demands are then determined by wrapping the maximum responses resulting from the specified seismic analyzes.

8. The popularity of nonlinear seismic analysis in engineering practice casts doubt on the validity of conventional lateral load models used to estimate inelastic demands.

9. The objective of this article is to develop alternative methods of multimodal seismic analysis by indirectly counting contributions in a higher way, while maintaining the simplicity of invariant distributions in a theoretically coherent way.

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