Comparative analysis of a 50 Storey RCC Frame with shear wall for conventional loading and construction sequence loading.

ANKUR DUBEY 1, Dr. Sudhir S Bhadauria 2

1 Student, Department of Civil Engineering University Institute of Technology (UIT) RGPV Bhopal, India
2 Guide and. Prof. Department of Civil Engineering University Institute of Technology (UIT) RGPV, Bhopal India.

ABSTRACT-*Most of the tall frame structures are analysed and designed by using linear static analysis which means that is load is applied on a single step on the assumption that the structures is subjected to full load at the top most floor at once that is when the whole structure is constructed entirely. But to accumulate actual ground scenario in designing method we have to consider this fact that a structure is made sequentially and not as a whole, and hence the load also applies in similar fashion. In this paper, a rigid multi-storeyed frame structure of reinforced cement concrete with shear wall model has been taken and have been analysed for effect of sequential analysis. The values essential for designing such as axial force, moments, vertical displacement have been noted which is essential for column and beam design and plotted in form of graph for a particular column.*

KEYWORDS -Ductility, Nonlinear behaviour, Shear wall, sequential analysis, Dead load.

1. INTRODUCTION

High-rise buildings are being made everywhere in present world. The dimensions such as height of high-rise buildings are getting larger and larger day by day. It has been noticed that structural design of high-rise buildings is very much dependent on dynamic analysis for winds and earthquakes. Since, in present scenario use of computer has progressed remarkably, almost all structural designers use software for the analysis and structural design of high-rise buildings. Hence, after that the determination of structural plan and outline of high-rise buildings, the structural design of individual structural members has been done by using various structural software. This analysis procedure by structural software makes it more important that the structure model becomes more realistic and field oriented in nature. Assumptions have been made over the past few decades that the multi-storied frames have been analyzed, taken into consideration that all the loads coming over the structure to be constructed namely dead weight of structure that is self-weight, the load due to objects present in structure that is live load, superimposed load and lateral load are applied on the completed frame at the same time instant that is final stage after completion of structure. However, in actual scenario the construction of the frame takes place storey by storey that is stage by stage that is in a sequential order and loads are applied accordingly on a frame in a sequential manner. The variation present or observed in the performance of the framed structure is due to fact that the difference between theoretical and actual construction practice manner. In order to analyze the structure for the designing phase the structural analysis must be done according to the actual construction practice that is staged analysis fashion and hence construction sequence analysis is used.

We are observing or noticing in current scene of construction that the height of structures is increasing drastically, but the challenge lies in the stability of structure. The powers that are exerted upon high rise buildings are forces like Seismic force, wind forces etc., and leave their impact. Immoderate self-heaviness or weight is a factor of uncertainty and also a problem which may lead to failure of frame if the stresses of forces cross the bearable limit, therefore over safe frame is designed to overcome these limitations.

We are looking to reasonable, affordable and economic solutions of building construction which cannot be carry through if over safe design is taken into account and it may also lead to high cost of structure. In consequence of that analysis which is error free is compulsory or we can say a must standard of judgment for multistoried frame to achieve stability, safety and economy. Work suggested seeks to find out more realistic and accurate way to analyze a structure to achieve the required parameters in realistic, economical and safety of frame.

2. CONSTRUCTION SEQUENCE ANALYSIS

Construction sequence analysis (CSA), also called as staged construction analysis, and it is a static form of analysis which is nonlinear in nature for any structure which may be of any kind which takes into consideration the logic of incremental loading. Loads on the constructed building frame are applied in stages as the work of construction of the frame proceeds. Due to taking into consideration the different stages of load application on constructed structures, this method is more valuable ,accurate ,practically implemented and field oriented. High rise buildings are constructed such that the construction of one floor takes place at a time, and after attainment of required strength of that stage work of next floor above it starts, therefore to get actual

analysis within the same phase of construction, the construction sequence and loading time have to be seen. So, it is observed that the post results of simultaneously applied load on to a structure can be different as compared to actual conduct. Since during the construction process the structural members are added in phases/stages as the construction of a building proceeds and therefore their dead load is carried by the part of the structure completed at the stage of their installation. Staged construction analysis takes into account the various stages in which load are applied, for strength, stability and deflection at the end of each step, therefore the sequencing or ordering of construction of components of the building should be taken into account. Staged construction show some changes at the time of analysis due to this reason it is assumed as static but nonlinear type of analysis. Construction Sequence analysis or we can say stage construction or incremental construction are terms referring to process of staged construction. At some places it is also written as segmental construction. As the construction of structure of building proceeds, the members of structure are added to structural frame in stages and thus dead load of member added is taken by part of the structure completed at the stage of structural member installation. Therefore, the accumulation or distribution of stresses and displacement can be obtained correctly or more accurately by adding or accumulating the results of analysis at each stage. The Linear static method takes into account or we can say counts the net total effect of the completed or the final stage or of the upper most floor of construction that is the end stage consideration of the completed construction without considering step by step effect of load which is nonlinear effects for sequential construction. The output thus generated is not reliable for high rise framed structures. So, it becomes a vital necessity to perform sequential analysis that is construction sequence analysis for structure having many floors, otherwise the results may lead to improper, inappropriate, faulty deign which may leads to destruction. The Segmental construction is one which always allows addition and removal of portion of structure is possible. An important component of generated force which is very crucial for stability that is shear force, which supports beam ,is improved using staged analysis. It has also been noticed that a considerable change which is of great importance for design that is values of displacement and axial force are also improved. The values of generated moment which be in any axes frame for both steel frame and reinforced cement concrete frame is widely improved. So, by keeping above points in mind construction sequence analysis is widely take into consideration before design phase.

3.SHEAR WALL

Shear walls, a term which has been of great importance for civil engineers specially for high rise frame structures. In addition to general structural elements like slabs, beams columns, multi framed structure are also sometimes equipped with vertical plate-like reinforced walls called shear walls. These walls generally start from foundation level and they are made continuous throughout the floors of building. They can have minimum thickness say of 150mm, or as high as 600 mm in high rise buildings. Shear walls are capable enough to carry earthquake loads downwards to foundation just like vertically-oriented wide beams .Shear walls have proved their effectiveness in past by showing very good performance during earthquakes which is one of the major threats to the high rise framed structures. The high success of structures specially multistoried buildings with shear walls in resisting strong earthquakes is summarized in the quote “We can’t afford to create concrete buildings meant to resist severe seismic forces generated during earthquakes without shear walls” Mark Fintel, a noted consulting engineer in USA. But it must also be noted that shear walls in high seismic regions require special detailing. Most earthquake prone countries have adopted shear walls like Japan, Chile, New Zealand , USA and now in India also. Shear walls are effective and efficient, both in terms of economics of construction and effectiveness in minimizing seismic damage in nonstructural and structural elements of structure. Shear walls can be easily implemented at sites because reinforcement detailing of walls is not complicated and is relatively straight-forward.

4. METHODOLOGY

In the present study as stated SAP structural software is used. In the present analysis a multistoried frame has been analyzed at 50 storey. The frame has been extended in present study up to 50 level and since the height is considerably large and keeping in mind effect of various disturbing forces the provision for shear wall is provided. The shear wall has been symmetrically arranged at four locations at the center of inner periphery of walls. The thickness of shear walls has been kept as 400 mm.

Table-1 Structure details

Type of structure	RCC framed structure
Grade of concrete	Grade M 25
Grade of steel	Fe 415
Floors	50 storeys

Height of each storey	3 m
External wall	230mm thick
Corner columns	300mm x 300mm
Outer columns	300mm x 350mm
Inner columns	300mm x 350mm
Plinth beams in X direction	230mm x 300mm
Plinth beams in Y direction	230mm x 350mm
Beams in X direction	230m x 400 mm
Shear wall thickness	400 mm

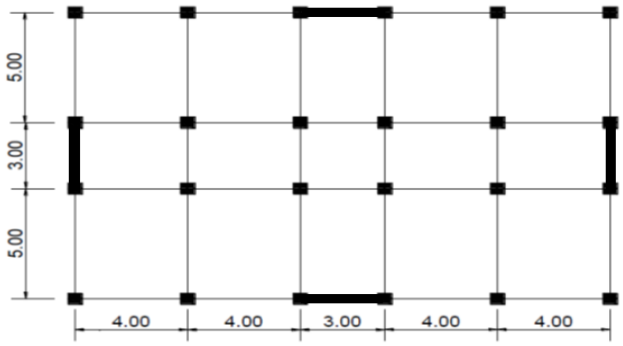


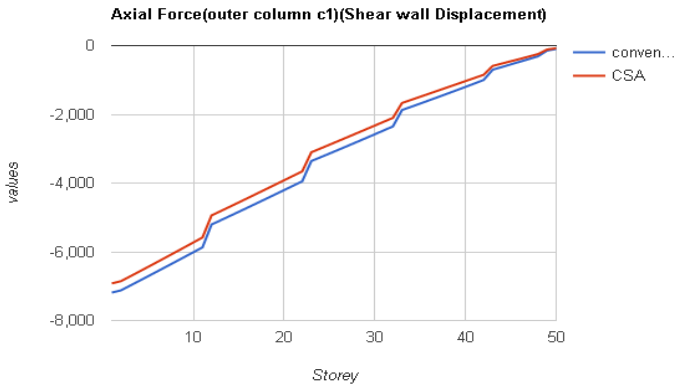
Figure 1-Plan of the considered building

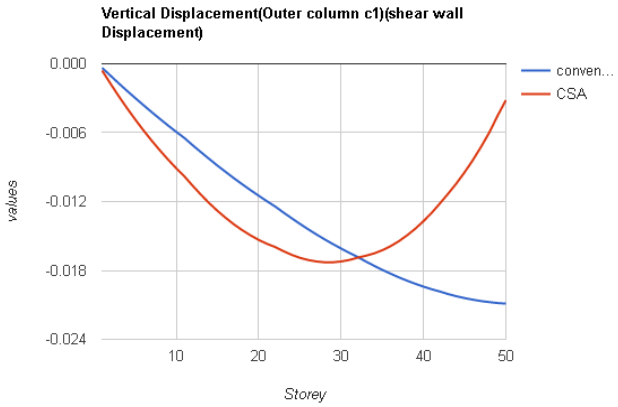
Table 2-List of dead loads considered

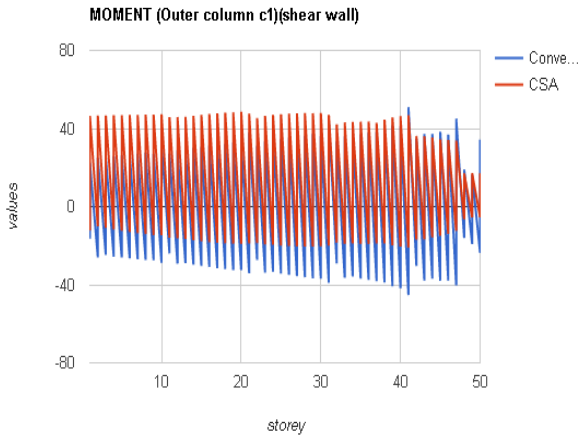
List of Dead load considered as per IS 875:1987 (part 1)	
Material / Load	Intensity /Density
Density of concrete	25 Kn/m3
Floor Finish	1Kn/m2
Roof Treatment	1 Kn/m2
Internal Wall load	9 Kn/m
External Wall load	13 Kn/m
Parapet Wall load	4.6 Kn/m
Live load	3 Kn/m

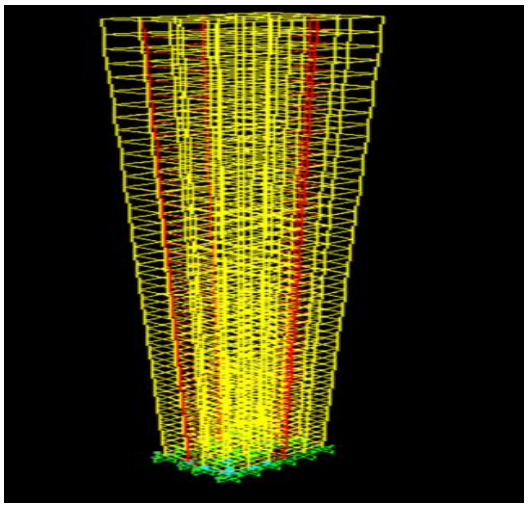
5.RESULT

The comparative analysis has been done and values have been noted for dead load of structure through conventional analysis and construction sequence analysis. In this paper graphs have been shown for a particular location i.e. for the Column of shear wall. The variation in response of structure have been shown by help of three graphs showing variation of a particular component with respect to number of floors between conventional analysis and CSA

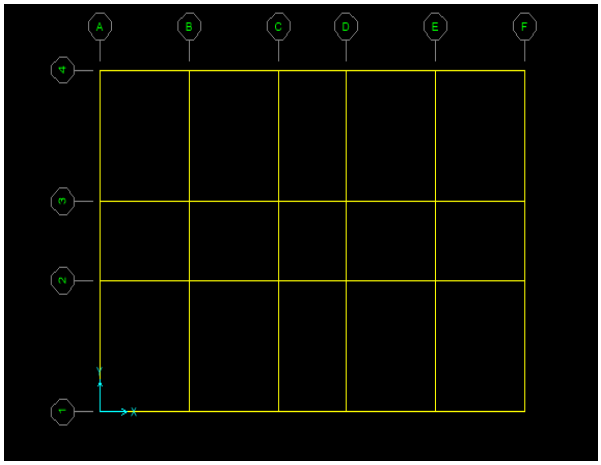








50 STOREY MODEL USING SAP SOFTWARE.



PLAN SHOWING LOCATION OF COLOUMNS

6. CONCLUSION

1. The effect of construction sequence analysis is significant over the conventional analysis for designing columns.
2. Interior columns experiences more axial force as compared to exterior columns, hence designed for actual load considering CSA.
3. Differential shortening in bottom half of structure is more for sequential load case, which must be taken into account in designing beams and slabs.
4. Construction sequence analysis is proved to be critical even for gravity loading structure, without considering earthquake forces.
   Hence construction sequence analysis for any structure will provide more reliable results for designing.

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