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REVIEW PAPER ON COMPARATIVE SEISMIC ANALYSIS OF RCC, STEEL AND COMPOSITE FRAME

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ABSTRACT

At the present era of the construction industry RCC is the famous material which is being used as construction material. RCC gives many structural advantages like lesser deflection, very high compressive strength etc. and it also gives economical advantage as well. Steel and steel-concrete composite material can also be used as construction material because these materials also have some very useful advantages like increment in speed of construction, increase in ductility of structure. Now earthquake is very important factor that must considered while designing of building otherwise it can be very hazardous to the building in safety point of view. Due to earthquake, buildings get subjected to loading causes building to deflect. Therefore comparative seismic study will be very useful for evaluating the performance of those buildings under the application of earthquake loads. So the main parameters which can used for study the performance are base shear, storey drift, maximum storey deflection, mode shapes and time period. For calculating those parameter IS 1893 has given different methods and these methods are neatly programmed in STAAD PRO and ETABS software which are commonly used for structural designing purpose.

Keywords:Base shear, Storey drift, Node deflection, Equivalent static, Response spectrum.

I. INTRODUCTION

Reinforced concrete is the material which is very commonly used as construction material because it gives some very useful advantages. As we know concrete is very strong in compression and very weak in tension. This weakness of concrete is fulfilled by steel which is added to the concrete before the placing of concrete at desired location and in desired orientation. But reinforced concrete takes some time to gain the desired strength which slows down the process of construction. This drawback of concrete can be overcome by steel or steel-concrete composite material which not only increase the speed but also impart ductility to the structure which ensures large deflection of structure before failure. Steel-concrete composite material can be formed by connecting those two materials in desired way according to their strength and weakness by means of shear connector or any other types of connector.

Earthquake is natural phenomenon in which movement of earth crust occurs due to several reasons like tectonic movement on faults. Due to this, huge amount of energy get released which propagates through earth's body in the form of transverse or longitudinal wave. As soon as these waves reach at the building location, building gets subjected to earthquake loads due to movement of underlying strata of the building. The force introduced due to earthquake is always dynamic in nature due to this building under goes deflection which is also the function of time. That dynamic force causes building to vibrate. As like any vibrating object has some time period building structure also has the same. Time period is the one of the most significant parameter which influences the magnitude of the earthquake load. If building has large time period is subjected to low forces and it undergoes high deflection and vice versa. Like the time period, there are several seismic parameters such as maximum storey deflection, storey drift, mode shapes, base shear which are very important for evaluating the performance of building. Therefore for comparing the performance of the building, firstly we have to compare these parameters.

These parameters can be calculated using various methods like Equivalent static method, Response spectrum method, time history analysis as suggested by IS 1893. We can use software like STAAD PRO or ETABS for analysis in which these methods are programmed very neatly. The result given by STAAD PRO or ETABS can be thoroughly studied and some very useful comparative conclusion can be made from this study.

1.1 COMPARISON OF RCC AND COMPOSITE BUILDING ON THE BASIS OF COST, SHEAR FORCE, BENDING MOMENT, NODE DISPLACEMENT,TOTAL WEIGHT

(Shashikala Koppad, Dr. S.V. Itti)

Steel concrete composite can be formed by connecting steel beams with concrete slab by shear connector, so they will be act as unique member .In this paper this composite is compared with RCC. They take the B+G+15 Storey residential building and analyzed in seismic zone III using STAAD PRO Vi8s software and earthquake loading was taken as given by IS 1893(part1) 2002. In this they found that cost of composite building get reduced by 27% than that of RCC also value of shear force & bending moment was more in RCC than composite. The node displacement was lesser in RCC structure & the weight of RCC structure was high. They also suggested that composite structure is best for high rise structure.

1.2 COMPARATIVE STUDY OF 10, 20, 30 STOREY RCC & COMPOSITE BUILDING ON THE BASIS OF TOTAL WEIGHT, AXIAL FORCE *(Prof. S. S. Charantimath, Prof. Swapnil B.Cholekar, Manjunath M. Birje)*

In this paper, 10, 20 & 30 storey RCC & composite building was taken for comparison. For the comparison, seismic zone III was taken and those building models were analyzed in ETABS 2013 software using equivalent static method & response spectrum analysis. The results were found such that the reduction in total weight of the composite structure was by 22.64%, 24.19% and 28.95% than that of RCC building for 10, 20, 30 storey building respectively. The reduction in axial force in column for composite building as compared RCC building was by 24.55%,24.28 and 40.61% for 10, 20, 30 storey building respectively.

1.3 COMPARISON OF THE RCC, STEEL & COMPOSITE STRUCTURE ON THE BASIS OF AXIAL FORCE IN COLUMN *(Dr. Panchal, P.M. Marathe)*

In this study, steel-concrete composite, steel, RCC building was taken for comparison. Model of G+30 storey of commercial building was taken and seismic zone IV was chosen for the analysis. Equivalent static method was used and building was analyzed using ETABS software. From this analysis it was found that axial force in column reduced by 34% and 5%in steel and composite respectively. Conclusion of present study is that steel is better option for high rise building than RCC & composite.

1.4 COMPARATIVE SEISMIC STUDY OF THE COMPOSITE, RCC & STEEL STRUCTURE ON THE BASIS OF BASE SHEAR, LATERAL FORCES, MAXIMUM DISPLACEMENT IN X & Y DIRECTION, MODAL FREQUENCY *(Varsha patil, Shilpa Kewate)*

In present work steel, steel-concrete composite & RCC material is compared by equivalent static method as well as by response spectrum analysis. For that G+5 storey commercial building situated in seismic zone III was analyzed in ETABS software. From this study, it can be seen that base shear for composite structure is reduced by 30% & 2% than that of RCC & steel respectively. Lateral forces for RCC building were higher than other two type of building. Maximum displacement in x-direction was reduced for composite building by 25% and 1.5% than RCC & steel building similarly in y-direction by 14% and 7.8% than RCC and steel respectively. The frequency for the composite structure was increased by 7% and 14% than steel and RCC structure respectively.

1.5 COMPARISON OF RCC, STEEL & COMPOSITE FRAME ON THE BASIS OF STOREY DRIFT, BASE SHEAR & COST EFFECTIVENESS *(Ch Geetha Bhavani, Dr. Dumpa Venkateshwarlu)*

In this paper 3D, G+7 model of frame was taken for analysis. Seismic Zone V was taken as the seismic zone of the building for analysis. Software used for analysis was STAAD PRO. The frame was analyzed in STAAD PRO using equivalent static and response spectrum method. From this analysis, the value of storey drift for steel frame was more than that of composite and RCC followed by composite frame. Base shear for RCC structure was higher because of its weight and get reduced by 40% & 45% for composite and steel frame respectively. Cost reduction was 27% & 33% for steel & composite frame respectively.

II. CONCLUSIONS

From literature studied it is concluded that –

1) For comparative seismic analysis different methods used are equivalent static method and response spectrum method.

2) ETABS and STAAD PRO software are used for seismic analysis.

3) Parameters used for the comparative study are story drift, base shear, lateral force, node displacement, cost effectiveness, shear force, bending moment, axial force in column, modal frequency, maximum displacement in X & Y direction and total weight of the structure.

4) According to literature studied the story drift for steel structure is more followed by composite and then by RCC structure. Also node displacement for RCC structure is less as compared to other two materials.

5) The value of base shear is greater for RCC which results in to application of large amount of lateral force on the RCC structure. Steel structure comes after RCC and composite structure falls last in terms of magnitude of base shear and lateral force.

6) The value of axial force for RCC structure is higher than that of composite and steel structure. In steel structure the amount of axial force was less as compared to other two materials. Also the reduction in axial force in composite member than RCC member is increasing as number of storey is increasing.

7) Shear force and bending moment is found to be less in composite member as compared to RCC member.

8) The value of modal frequency is higher for composite structure followed by steel and then by concrete structure.

9) The composite structure found good in terms of cost reduction, steel comes second after composite structure in this category, RCC comes last means RCC is costliest one.

10) The weight of the composite structure was less than the RCC structure and the reduction in weight of composite structure than RCC structure is goes on increasing as the number of storey of the structure is increasing.

11) The maximum displacement in both horizontal orthogonal direction is more for RCC followed by steel and then by composite structure.

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