A review paper on composite structure used in column for various analysis

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Abstract - India is a developing nation but steel consumption in construction sector in India is on very much lesser side as compared to other developed nation in the world. Due to tremendous increase in population, development concentration around urban areas and limited land chunks the population density in cities is increasing day by day. The increased population density resulted into growing demand of high rise buildings. In high rise building due to accumulation of load of all stories, vertical gravity load of columns dominates the design of building structure. Composite structure is being used as an alternate to steel structures due to its benefits over RCC structure and high cost of steel structure.

In this paper we are presenting review of literature done in past related to composite members and structural analysis.

keywords: composite member, analysis tool, high rise building, stability, forces, deflection.

I. INTRODUCTION

In general majority of the civil structures are designed with the assumption that all applied loads are static. The effect of dynamic load is not being considered because the structure is rarely subjected to dynamic loads, more its consideration in the analysis makes the solution more complicated and time consuming. This aspect of neglecting dynamic forces may sometimes become the cause of disaster. Particularly in case of earthquake.

Campian et. al, (2015): Steel-concrete composite structure implies steel section encased in concrete for columns and the concrete slab or profiled deck slab is connected to the steel beam with the help of mechanical shear connectors so that they act as a single unit. Steel-concrete composite with Reinforced cement concrete options are considered for comparative study of G+15 storey office building which is situated in earthquake zone IV and for earthquake loading, the provisions of IS:1893(Part1)-2002 is considered by Equivalent Static Method of Analysis. For modeling of Composite & R.C.C. structures, STAAD. pro software is used. In this study, the seismic design and performance of composite steel-concrete frames are discussed in particular. Comparison of parameters like time period, displacement, moments and load carrying capacity is done with steel and Reinforced cement concrete structures. The results are compared and it is found that composite structure are more good in several aspect.

During test, it has been observed that columns constituted with high strength concrete failed suddenly due to cracks but when normal strength concrete is used for composite columns, it failed slowly and bearing capacity reduced steadily.

This experimental study confirms that fully encased composite columns can be used as an alternate solution for seismic and non-seismic areas due to its better performance. Composite columns with HSC exhibit brittle failure pattern during experiments hence there is a further scope of experimental research in this area.

Netravathi et. al, (2017): In this paper conventional R.C.C. Column and composite column performance was studies by performing analysis one tabs by response spectrum. Regular and Irregular structures were studied for composite columns against conventional R.C.C. Column.

In regular structures for rectangular/ circular composite column section displacement reduced by 40% to 50% but shear increased by 60% to 70% and drift increased by 35% to 40%.

In irregular structures also displacement reduced by 40% to 50% but shear increased by 60% to 70% and drift increased by 35% to 40%. This may be concluded as shape of structure does not have any effect on using composite columns.

In this research work all the elements selected were composite sections so there is a further scope of exploring performance of individual composite elements with other structural elements of R.C.C.

Renavikar et. al. (July 2016): they did Comparative Study on Analysis and Cost of R.C.C. and Steel-Composite Structure. The paper involves Analysis of a residential

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building with steel-concrete composite and RCC construction. The proposed structure is a four multi-storeyed buildings of G+9, G+12, G+15, G+18, with 3.0m as the height of each floor with (plan dimension 15m x 9m). The analysis done by 2D modelling using software STAAD-Pro 2007, load combinations taken as per the IS Code. The project involves analysis of an equivalent RCC structure so that a cost comparison can be made between a composite structure and an equivalent RCC structure. Because of the inherent ductility characteristics, composite structure will perform better than conventional RCC structure. The axial forces, seismic forces, bending moment and deflections in RCC are more as compared to the composite structure. There is the reduction in cost of steel structure as compared to RCC structure due to reduction in dimensions of elements. Composite option is better than RCC for high rise building because Weight of composite structure is low as compared to RCC structure which helps in reducing the foundation cost and it is subjected to fewer amounts of forces induced due to the earthquake Composite structure is more economical than that of RCC structure. Composite structures are the best solution for high rise structure as compared to RCC structure. Speedy construction facilitates quicker return on the invested capital and benefits in terms of rent.

Murtuza S. Aainawala (June 2016): He assess and think about the seismic execution of G+15 story made up of RCC and composite structures by ETABS 2015 programming. Both steel and solid composite structures having concrete filled steel tube and RCC structures were having delicate story at ground level, structures were situated in the locale of quake zone IV on a medium soil. Equal static and reaction range strategy is utilized for investigation. Story float, Displacement, self weight, twisting minute and shear drive, are considered as parameters. At the point when analyzed composite structures indicates preferred execution over RCC.

Shah et. al, (2013): They studied the comparison of structural behavior of R.C.C. and composite structure of multistory building. For this a model of G+15 stories located in seismic zone IV prepared on structural analysis and design software (STADD PRO).The wind load of velocity 39 m/sec was applied. The conclusions of above study are below-

- Deflection is within permissible limit but deflection and drift is twice than R.C.C. structure.
- In X direction there is less bending moment in composite column.
- In Z direction there is no change in bending moment of column.
- Axial force and shear force in composite structure is on lower side.
- In R.C.C. structure maximum B.M. of beam is on lower side than that of Composite structure.
- R.C.C. structures are costlier than composite structure.
- Composite structure facilitates speedy construction.
- Dead weight due to composite structure reduced significantly.
- Composite structure is best alternate for high rise building.

Jingbo et. al, (2008): Steel-concrete composite construction means steel section encased in concrete for columns & the concrete slab or profiled deck slab is connected to the steel beam with the help of mechanical shear connectors so that they act as a single unit..Steel-concrete composite with R.C.C. options are considered for comparative study of G+5 storey office building with 3.658 m height, which is situated in earthquake zone III(indore)& wind speed 50 m/s. The overall plan dimension of the building is 56.3 m x 31.94 m.Equivalent Static Method of Analysis is used. For modeling of Composite & R.C.C. structures, staad-pro software is used and the results are compared; and it is found that composite structure more economical.

Its result exhibit that for CL frames, the structural stiffness increases. Top floor deflection and maximum drift angle decreased by 18%. To meet the seismic requirement for R.C.C. column larger sections are required.

- Deformation criteria used to determine members dimension, It was observed that for R.C.C. frame under elastic deformation large section sizes are required as compared to composite sections.
- Inelastic time history analysis shows the value of floor drift angle is less and it changes steadily with the change in height of building. Due to increase in stiffness of composite beam, linear stiffness ratio of beam to column and global structural stiffness both changes.

The frames with original R.C.C. column cannot resist sudden earthquakes however load carrying capacity and stiffness can be increased by increasing reinforcement ratio and increasing column dimensions but the self weight and earthquake action also increase accordingly.

Desai et. al., (2013): In this paper an attempt is made to study seismic performance of a soft story composite columns. Four different models were prepared and Stadd pro software was used to study their performance. In model -1, story height of building were kept uniform where as in model -2 only ground floor column were replaced by composite columns. In model -3 ground floor & first floor column were replaced by composite column on other hand in model -4 height of ground floor were changed to 4 mt.

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From above, it was observed that in model-1 stiffness of ground floor for composite column is more than R.C.C. column. In model -2 and model -4 i.e. providing composite column only on ground floor induce more stiffness than model -. It was suggested in above study that provision of shear wall should be made with use of composite columns to increase stiffness and ductility of soft story and first floor columns should be such that it is stiffer than ground floor columns.

Asha et. al. (2012): An analysis on G+12 story building was carried out using moment resisting frames. In this study composite columns were compared against steel columns for structural performance parameters. Concrete of Grade M-30, Reinforcement steel of grade Fe-500 and structural steel of Grade Fe-250 used by assuming that structure is located on hard soil/ ordinary rock strata in seismic Zone – II. The structural design software e-tabs used for carrying out analysis of building structure with steel columns and concrete filled steel tubes. The outcomes are as below –

- In composite column structure base shear and story overturning moments is 22% to 28 % less than that in steel columns for seismic load of Zone-II.
- Story drift for Zone-II in steel columns is higher for lower stories by 25% to 28% when compared with composite columns.
- Roof displacement is 26.6% more in case of steel columns when compared to concrete filled steel tubes (CFST) Columns.

Xilin et. al. (2011): Test was carried out on eleven composite column specimens at State key Laboratory with a purpose of reduction in disasters in civil engineering field. Cross section, grade of steel, configuration of structure, connection methods and slenderness ratio were the parameters considered for evaluation seismic behavior of CFRT columns.

Axial and lateral loads were applied on the specimens and specimen behavior was monitored, slight local buckling deformation primarily occurred.

CFRT Columns exhibit better seismic performance under cyclic loading, it shows good resistance against local buckling when compared to normal reinforced cent concrete columns. During evaluation of result, it was considered that strength increases with thickness of tubes. High strength concrete columns have lower energy dissipation and larger strength degradation.

Soni et. al. (2010): Ground and Five stories, 3D frame, is analyzed for seismic forces on Stadd Pro Software. Three different type of frame is considered, one RCC frame with RCC slab, Second steel frame with steel plate slab and third steel beams with RCC column & slab. Support reaction, support moment and nodal displacement for RCC and steel were compared for medium soil for Seismic Zone – III.

It observed that as compared to RCC and steel structure the nodal displacement in composite structure is less. The support reaction for composite structure is less than RCC and Steel structure so the design of foundation will be lighter & cheaper. For earthquake resistant structure, Composite structure is a better solution from design criteria and same can be erected faster as well as economically feasible than steel structures.

Baier et. al. (2010): The themes of the study are composite structural components. For this purpose have been designed and built several research positions. Using different structural materials to build new device components requires multiple tests of the components. Research posts were designed in the advanced graphical program CAx Siemens NX 7.5. Analysed samples were made from the glass fibre, aramid and carbon of various weights. Due to the specific use of composite materials it focuses on the elements in the form of plates and flat bars. For the examination of experimental strain gauge technique was used bead, the force sensor and displacement sensor. The experimental methods were compared with computer simulation using the FEM.

The aim of this study was to determine the basic material constants and a comparison of the experimental method and the method of computer simulation. The ultimate result will be knowledge on the different forms of laminates, such as material properties, the stresses in all layers, strain and comparing the results obtained by two methods. The expected outcome of the study will be the composition and method of joining composite laminate with a steel plate to the possible application in the repair and construction of structural elements of freight wagons.

II. CONCLUSION

Here Authors conclude that structure stability can be enhance using composite members, resisting forces. Here it can be said that for high rise structures composite supportive members can be useful for enhancing durability.

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