

Design and Economic Comparison of Rcc and Steel Reinforced Masonry Building

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ABSTRACT: Steel concrete composite construction has gained wide acceptance world wide as an alternative to pure steel and pure concrete construction. The use of steel in construction industry is very low in India compared to many developing countries. There is a great potential for increasing the volume of steel in construction, especially in the current development needs India and not using steel as an alternative construction material and not using it where it is economical is a heavy loss for the country. In this paper study of Four various multistoried commercial buildings i.e. G+12, G+16, G+20, G+24 are analysed by using STAAD-Pro software. Where design and cost estimation is carried out using MS-Excel programming and from obtained result comparison can be made between R.C.C and composite structure

INTRODUCTION Composite structures can be defined as the structures in which composite sections made up of two different types of materials such as steel and concrete are used for beams, and columns. This paper include comparative study of R.C.C. with Steel Concrete Composite (G+12, G+16, G+20, G+24) story buildings which situated in Nagpur earthquake zone II and wind speed 44m/s. 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. Comparative study includes deflection, axial force and shear force, bending moment in column and beam, cost. It is found that composite structure is more economical and speedy than R.C

II. COPOSITE MULTISTORIED BUILDINGS

The primary structural components use in composite construction consists of the following elements. 1. Composite deck slab 2. Composite beam 3. Composite column 4. Shear connector

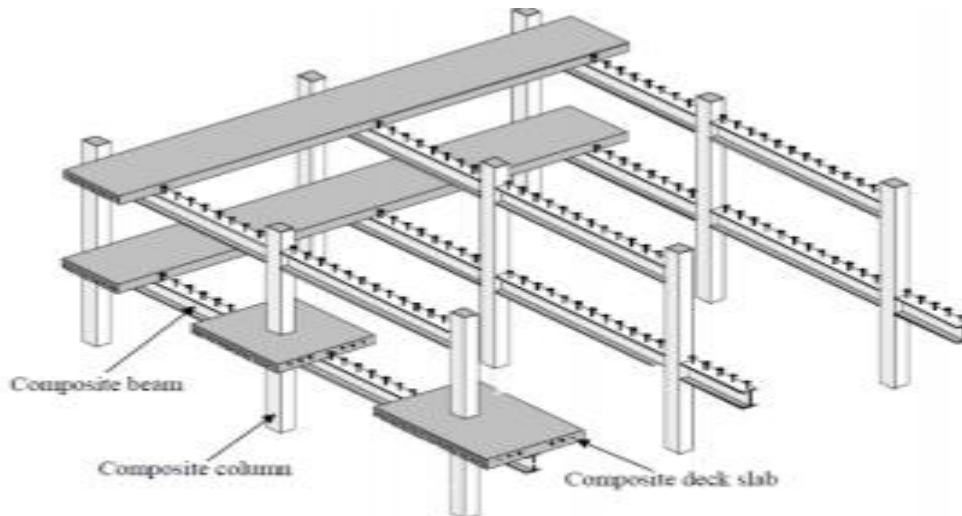


Fig.1: Steel-concrete composite frame

2.1. COMPOSITE DECK SLAB

Composite floor system consists of steel beams, metal decking and concrete. They are combined in a very efficient way so that the best properties of each material can be used to optimize construction techniques. The most common arrangement found in composite floor systems is a rolled or built-up steel beam connected to a formed steel deck and concrete slab. The metal deck typically spans unsupported between steel members, while also providing a working platform for concreting work. The composite floor system produces a rigid horizontal diaphragm, providing stability to the overall building system, while distributing wind and seismic shears to the lateral load-resisting systems. and stiffness by factors of around 2 and 3.5 respectively. The concrete forms the compression flange – the steel provides the tension component

and shear connectors ensure that the section behaves compositely. Beam spans of 6 to 12 m can be created giving maximum flexibility and division of the internal space. Composite slabs use steel decking of 46 to 80 mm depth that can span 3 to 4.5 m without temporary propping. Slab thicknesses are normally in the range 100 mm to 250 mm for shallow decking, and in the range 280 mm to 320 mm for deep decking. Composite slabs are usually designed as simply supported members in the normal condition, with no account taken of the continuity offered by any reinforcement at the supports.

2.2. COMPOSITE BEAM

In conventional composite construction, concrete slabs rest over steel beams and are supported by them. Under load these two components act independently and a relative slip occurs at

the interface if there is no connection between them. With the help of a deliberate and appropriate connection provided between them can be eliminated. In this case the steel beam and the slab act as a “composite beam” and their action is similar to that of a monolithic Tee beam. Though steel and concrete are the most commonly used materials for composite beams, other materials such as pre-stressed concrete and timber can also be used. Concrete is stronger in compression than in tension, and steel is susceptible to buckling in compression. By the composite action between the two, we can utilize their respective advantage to the fullest extent. Generally in steelconcrete composite beams, steel beams are integrally connected to prefabricated or cast in situ reinforced concrete slabs

2.2.1 COMPOSITE ACTION IN BEAMS

Composite beams, subjected mainly to bending, consist of section action composite with flange of reinforced concrete. To act together, mechanical shear connectors are provided to transmit the horizontal shear between the steel beam and concrete slab, ignoring the effect of any bond between the two materials. These also resist uplift forces acting at the steel concrete interface. If there is no connection between steel beam and concrete slab interface, a relative slip occurs

between them when the beam is loaded. Thus, each component will act independently. With the help of deliberate and appropriate connection between concrete slab and steel beam the slip can be minimized or even eliminated altogether. If slip at the interface is eliminated or drastically reduced, the slab and steel member will act together as a composite unit. Slip is zero at mid-span and maximum at the support of the simply supported beam subjected to uniformly distributed load. Hence, shear is less in connectors located near the centre and maximum in connectors located near the support. Composite beams are often designed under the assumption that the steel beam supports the weight of the structural steel or wet concrete plus construction loads. This approach results in considerably less number of connectors than they are required to enable the maximum bending resistance of the composite beam to be reached. However the use of such partial shear connection results in reduced resistance and stiffness.

2.2.2 ADVANTAGES OF COMPOSITE BEAMS

1. Keeping the span and loading unaltered, more economical steel section in terms of depth and weight) is adequate in composite

construction compared with conventional non-composite construction.

2. Encased steel beam sections have improved fire resistance and corrosion.

3. It satisfied requirement of long span construction a modern trend in architectural design.

4. Composite construction is amenable to fast track construction because of use of rolled steel sections.

5. Composite sections have higher stiffness than the corresponding steel sections and thus the deflection is lesser

6. Permits easy structural repairs/modification.

7. Provides considerable flexibility in design and ease of fabrication.

8. Enables easy construction scheduling in congested sites.

9. Reduction in overall weight of the structure and there by reduction in foundation cost.

10. Suitable to resist repeated earthquake loading which requires high amount of resistance and ductility.

2.3. COMPOSITE COLUMN A steel concrete composite column is a compression

member, comprising either of a concrete encased hot rolled steel section or a concrete filled hollow section of hot rolled steel. It is generally used as a load bearing member in a composite framed structure. Composite members are mainly subjected to compression and bending. At present there is no Indian standard code covering the design of composite column. The method of design in this report largely follows EC4, which incorporates latest research on composite construction. Indian standard for composite construction IS 11384-1985 does not make any specific reference to composite columns. This method also adopts the European buckling curves for steel columns as a basic of column design.

2.3.1 THE ADVANTAGES OF COMPOSITE COLUMNS ARE

1) Increased strength for a given cross sectional dimension.

2) Increased stiffness, leading to reduced slenderness and increased bulking resistance.

3) Good fire resistance in the case of concrete encased columns.

4) Corrosion protection in encased columns.

5) Significant economic advantages over either pure structural steel or reinforced concrete alternatives.

6) Identical cross sections with different load and moment resistances can be produced by varying steel thickness, the concrete strength and reinforcement. This allows the outer dimensions of a column to be held constant over a number of floors in a building, thus simplifying the construction and architectural detailing.

7) Erection of high rise building in an extremely efficient manner. 8) Formwork is not required for concrete filled tubular sections.

2.4. SHEAR CONNECTOR The total shear force at the interface between concrete slab and steel beam is approximately eight times the total load carried by the beam. Therefore, mechanical shear connectors are required at the steel-concrete interface. These connectors are designed to (a) transmit longitudinal shear along the interface, and (b) Prevent separation of steel beam and concrete slab at the interface. Commonly used types of shear connectors as per IS: 11384-1985. There are three main types of shear connectors; rigid shear connectors, flexible shear connectors and anchorage shear connectors.

2.4.1 TYPES OF SHEAR CONNECTORS

1. RIGID TYPE As the name implies, these connectors are very stiff and they sustain only a small deformation while resisting the shear force. They derive their resistance from bearing pressure on the concrete, and fail due to crushing of concrete. Short bars, angles, Tsections are common examples of this type of connectors. Also anchorage devices like hooked bars are attached with these connectors to prevent vertical separation.

2. FLEXIBLE TYPE Headed studs, channels come under this category. These connectors are welded to the flange of the steel beam. They derive their stress resistance through bending and undergo large deformation before failure. The stud connectors are the types used extensively. The shank and the weld collar adjacent to steel beam resist the shear loads whereas the head resists the uplift.

3. BOND OR ANCHORAGE TYPE It is used to resist horizontal shear and to prevent separation of girder from the concrete slab at the interface through bond. These connectors derived from the resistance through bond and anchorage action.

CONCLUSION Analysis and design of four various building can be done and comparison can be made between them and from that result conclusions can be drawn out are as follows:- 1. In case of a composite structural system because of the lesser magnitude of the beam end forces and moments compared to an R.C.C system, one can use lighter section in a composite structure. Thus, it reduces the self-weight and cost of the structural components. 2. From Fig.3 & Fig.4 it is seen that the downward reaction (F_y) and bending moment in other two directions for composite structural system is less. Thus one can use smaller size foundation in case of composite construction compared to an R.C.C construction. 3. Under earthquake consideration because of inherent ductility characteristics, steel-concrete composite structure performs better than a R.C.C structure. 4. In the cost estimation for building structure no savings in the construction time for the erection of the composite structure is included. As compared to RCC structures, composite structures require less construction time due to the quick erection of the steel frame and ease of formwork for concrete. Including the construction period as a function of total cost in the cost estimation will certainly result in increased economy for the

composite structure. 5. The cost comparison reveals that steel-concrete composite design structure is more economical in case of high rise buildings and construction is speedy.

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