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STUDY OF SEISMIC BEHAVIOR OF COMPOSITE FRAME STRUCTURE AND ITS COMPARISON WITH RCC STRUCTURE

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ABSTRACT

As the reinforced concrete structure is the most economic & convenient system, they are mostly used in India for low rise buildings. But, because of increased dead load, less stiffness, span restriction and hazardous formwork, for medium to high-rise buildings this type of structure is no longer economic. Therefore, the structural engineers are facing the challenge of striving for the most efficient and economical design solution. Composite material is used for particular interest, due to its significant potential in improving the overall performance through rather modest changes in manufacturing and constructional technologies.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 the present work, Multistoried Composite and RCC structure are analyzed and designed using software. Comparison includes structural parameters like Shear Force in columns, Twisting moments, Bending moments and axial force ,Deflection, Storey stiffness, Story Drift, displacement of both R.C.C. and Steel-concrete Composite building.Also it includes the seismic design and performance of composite steel-concrete frames i.e time history analysis.

KEYWORDS: Composite structure, RCC structure, time history analysis.

INTRODUCTION

The use of Steel in construction industry is very low in India compared to many developing countries. Experiences of other countries indicate that this is not due to the lack of economy of Steel as a construction material. There is a great potential for increasing the volume of Steel in construction, especially the current development needs in India exploring Steel as an alternative construction material and not using it where it is economical is a heavy loss for the country. The population of India is increasing day by day and they required land for living, for that multi story structures are best option for construction in metropolis cities where less land is available, because multi story structure provides large floor area in small land area. Therefore, it is essential to construct high rise buildings. The reinforced concrete structures are mostly used from many decades because of its stiffness, most convenience, high durability and ease to construct. The RCC structures are more suitable for low rise structure but for medium to high rise structures, it is no longer economical because of large dead load, less susceptible, span restriction and complex formwork. Structural designer is facing the problem of less susceptibility to lateral loads and also the problem of economy. If high rise buildings are constructed than many structural problems arise, such as lateral load effect, lateral displacement and stiffness etc. Generally for high rise structure wind and earth quake load effects are dominant. Therefore for high rise buildings it is essential to have knowledge of various loads and its effect on buildings. The effect of lateral load is very important to consider such as earthquake and wind loads. In some cases the wind load is dominant than earthquake load which depends on area and zone factor defined by codes. This wind effect will cause and produce wind induced motion in the structure. As high rise buildings push the envelope to greater heights, the structural designers are not only faced with problem to choosing a structural elements to carry the lateral load such as wind load and earthquake load but also insuring the design criteria that meets stability and serviceability requirement under complex wind environment. In addition, the high rise structures should meet more stiffness under lateral loads. Wind load act as lateral load on buildings which is act as along and across wind. In IS Code 875(Part3)-1987, the basic wind speed are given in map and categorized by zones. The shape ofbuildings is very important in wind analysis, because the wind pressure is mainly depends on the exposed area of building against wind.

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STEEL-CONCRETE COMPOSITE CONSTRUCTION

The primary structural component use in composite construction consists of the following elements.

- Composite Deck Slab
- Composite beam
- Composite column
- Shear connector

Composite Deck Slab

Composite floor system is built up with steel beams, metal decking and concrete. They are combined in such a way that the best properties of each material can be used to optimize construction techniques. Majority used arrangement in load carrying capacity and stiffness increases by factors of around 2 and 3.5 respectively using composite action.

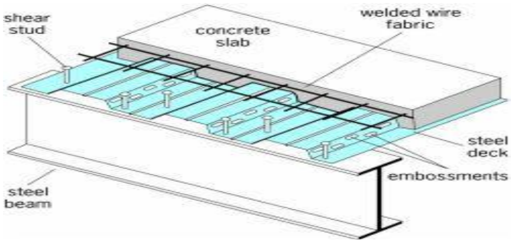

Fig. 1 Composite Deck Slab

Composite Beam

A concrete beam is formed when a concrete slab which is casted in-situ conditions is placed over an I-section or steel beam. Under the influence of loading both these elements tend to behave in an independent way and there is a relative slippage between them. If there is a proper connection such that there is no relative slip between them, then an I-section steel beam with a concrete slab will behave like a monolithic beam.

Composite Column

Comprising either of a concrete encased hot rolled steel section or a concrete filled hollow section of hot rolled steel having a steel concrete composite column is a compression member. It is normally used for composite framed structure as a load bearing member. Composite members are majorly subjected to compression and bending. Both concrete and the steel interact together by friction and bond in a composite column. Hence, they resist external loading. Typically, in the composite construction, the primary construction loads are beared and supported by bare steel columns. Concrete is filled inside the tubular steel sections or is later casted around the I section. The combination of both steel and concrete use their attributes in the most effective way.

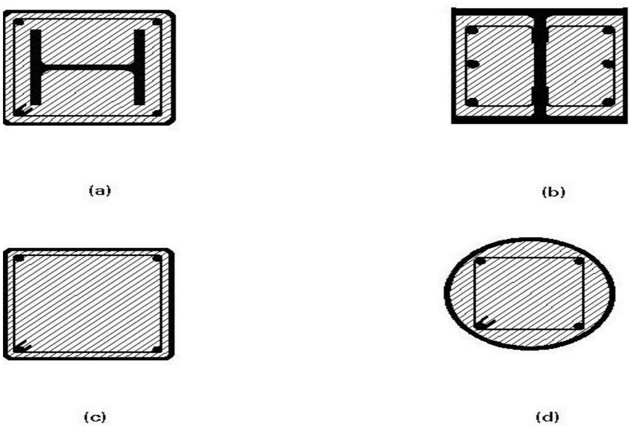

Fig. 2 Typical cross sections

SHEAR CONNECTOR

Composite construction consists of providing monolithic action between prefabricated units like steel beams or pre-cast reinforced concrete or pre-stressed concrete beams and cast-in-situ concrete, so that the two will act as

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one unit. Although there is bound to be a certain amount of natural bond between concrete and steel at least at the initial stages, this bond cannot be relied upon as the same is likely to be deteriorate due to use and over load. Mechanical shear connectors are therefore provided to help the steel and concrete element to act in a composite manner ignoring the contribution made by the inherent natural bond towards this effect. Primarily shear connectors are intended to resist the horizontal movement between the concrete slab and the steel beam and to transmit the horizontal shear between the two.

Types of Shear Connectors

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, T-sections are common examples of this type of connectors. Also anchorage devices like hoped bars are attached with these connectors to prevent vertical separation.

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 adjacentto steel beam resist the shear loads whereas the head resists the uplift.

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
Factors should be considered to decide structural suitability such as Seismic performance of the structure, Deformations, Resultant Forces and Moments, Cost, Weight, Fire performance. Overall response of composite structure is better than RCC structure i.e. composite structure produces less displacement and resists more structural forces. Composite structures are best solution for high rise buildings and they are resulted in speedy construction. Steel option is better than RCC but the composite option for high rise building is best. Steel has excellent resistance to tensile loading but prone to buckling and concrete gives more resistance to compressive force. Steel can be used to induce ductility and concrete can be used for corrosion and fire protection. Composite structures are resulted into lighter construction than traditional concrete construction as well as speedy construction. So completion period of composite building is less than RCC building.

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