Volume : 3 | Issue : 10 | October 2014 • ISSN No 2277 - 8179

Research Paper

Role of Composite Sections in a Multistoried Building

Engineering

KEYWORDS : Composite column, Composite beam Composite floor, shear connector, Non-linear finite element modeling; Semi-rigid behaviour

Laxmikant N. Vairagade G. H. Raisoni Academy of Engineering and Technology, Nagpur 441 110 (M.S.)

Dinesh W. Gawatre Sinhgad Academy of Engineering, Pune 411 048 (MS)

ABSTRACT

Steel-concrete composite members are an interesting option for structural designers, but the reliability of design procedures both in the case of gravity and seismic loads is in continuous development. composite steel concrete design provide a significant economy through reduced materials and faster construction, such system make use of each type of member in the most efficient manner to maximize the structural and economic benefits. In this project, theoretical, numerical aspects and applications concerning the seismic behavior of steel-concrete composite structures are to be analysed.

The interest has been focusing in this area on the capability of composite framed structures to dissipate seismic energy by means of inelastic deformations with the objectives to: (1) Apply non linear analysis methods to evaluate building performance. (2)The principal features affecting the seismic response of composite frames. (3) A numerical analysis has been conduct to investigate the influence of composite behavior of the structures.(4) A finite element modal has been develop to account for the dynamic behavior of composite structure and (5) The influence of shear connector on the behavior of composite framed structure in seismic loading.

INTRODUCTION

The most important and most frequently encountered combination of construction materials is that of steel and concrete, with applications in multistory commercial buildings and factories as well as in bridges. The basic principal underlying composite construction is that certain materials may be used more effectively in certain types of stressed conditions; thus, the combination of a material strong in compression with one strong in tension makes a very economical union for its use in structures. With basic materials such as concrete, steel, masonry materials, wood, and timber, a number of successful combinations can be used. These essentially different materials are completely compatible and complementary to each other; they have almost the same thermal expansion; they have an ideal combination of strengths with the concrete efficient in compression and steel in tension; concrete also gives corrosion protection and thermal insulation to the steel at the elevated temperatures and additionally can restrain slender steel sections from local or lateral buckling. In multistory building, structural steel work is typically used together with concrete; for example, steel beams with concrete floors slabs. The same applies to the road bridges, where concrete decks are normally preferred. It is fact, however, that engineers are increasingly designing composite and mixed building systems of structural steel and reinforced concrete to produce more efficient structures when compared to designs using either material alone. It should be noted that the combination of concrete cores, steel frames and composite floor construction has become the standard construction method for multistory commercial buildings. The structural steel/reinforced concrete frame is the standard system for tall building, the main reason for this preference is that the sections and members are best suited to resist repeated earthquake loadings which requires high amount of resistance and ductility. A further more important consideration is that the use of rolled steel sections,

Profiled metal decking and prefabricated composite member's speeds up execution. And also composite floor construction is highly competitive if spans are increased to 12 to 15m or even 20m. There is, of course, a demand for larger column-free spans in buildings to facilitate open planning or greater flexibility. Recycling of hazardous wastes use in construction materials and the environmental impact of such practices have been studied for many years (Cyr et al., 2008). In fact, there is a great scope for Setting up secondary industries for the recycling and use of huge solid wastes in construction materials,

Composite beam

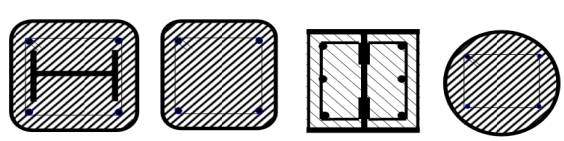
Composite beams, subject mainly to bending, consist of a steel section acting completely with one (or two) flanges of reinforced concrete the two materials are interconnected by means of mechanical shear connector.

If slip is free to occur at the interface between the steel section and the concrete slab, each component will act independently. If slip at the interface is eliminated, or at least reduced, the slab and the steel member will act together as a composite unit. The resulting increase in resistance will depend on the extent to which slip is prevented; the degree of interaction depends mainly on the degree of shear connection used.

Composite column

Three different types of composite columns are principally in use-

- Concrete encased steel columns (a)
- Concrete filled steel tubes (c&d)
- Rolled section columns partly encased in concrete (b)



a b c d

COMPOSITE VS. NONCOMPOSITE ACTION:-

1. Concrete filled steel tubes and cased rolled shapes possess higher strength than the reinforced concrete column of comparable size. (Research as reported by Furlong (1968), Gander and Jacobson (1967), and Stevens (1965)).
2. Encasing steel sections in reinforced concrete is particularly beneficial for earthquake resistant design.(Okamoto(1973)).
3. Jonson et al. (1966) report design studies of composite frames for buildings designed both elastically and plastically according to British specification as follows.

Type of frame	Weight%	Cost%
Elastic non composite	100	100
Plastic non composite	95	102
Elastic composite	86	91
Plastic composite	66	90

4. from the point of structural advantage:-

i. Depth of steel beam is reduced to support a given load

ii. Composite columns helps to reduce the effective slenderness ratio of a steel column, thus increasing its buckling load Further more; the concrete encasement also carries its share of loading according to the actual behavior of composite columns under load.

iii. For a given load, a reduction in dead loads and construction depth reduces

iv. Composite construction is amenable to *"fast-track"* construction because of using rolled steel and pre-fabricated components, rather than cast-in-situ concrete.

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

The following assumptions are normally utilized for the formulation of the basic composite plane frame analysis (Vallenilla, 1987). It is emphasized that nonlinear analysis techniques, such as those used to evaluate pure steel frame and reinforced concrete frame behavior, can be applied to composite frames as well.

1. The building is a rectangular grid pattern. Story height may vary arbitrarily, as may the bay widths in each direction. However, it is assumed that the columns extend continuously from base to top and the girders from side to side.
2. The members are straight, prismatic and symmetric about the plane of the frame.
3. Loads are applied in the plane of the frame, and only at the end of the elements.
4. Only in plane deformations are considered.
5. Only half of the concrete cross section remains un-cracked after the composite columns are loaded.
6. The steel has a linearly elastic-perfectly plastic stress-strain relationship.
7. Slip does not occur between steel and concrete.
8. Lateral Tensional buckling does not occur.

RESEARCH NEEDS

1. The floors using profiled deck slab is a very new design concept and it gives more realistic and economical design.
2. Analysing the composite structure with a new method "AUTO STRESS METHOD"
3. Apply nonlinear analysis methods to investigate the more realistic building performance.
4. Detailed analysis to be conducted to investigate the influence of Beam-column Joints.

Components that will reduce the cost of Construction some extent. Therefore, the entrepreneurs and construction agencies must be encouraged to develop new products and processesusing the solidwastesas raw materials, thus paving the innovative way for setting up secondary-industries.

CONCLUDING REMARKS

1. The main reason for this preference is that the sections and members are best suited to resist repeated earthquake loadings which requires high amount of resistance and ductility.
2. The steel members are relatively vulnerable against the compressive forces. However the combination with the concrete can greatly improve the bending strength because the concrete restricts the excess buckling of steel members in compression.
3. The composite flexural strength of a composite slim floor beams can be calculated by plastic method (the so called rectangular stress block method).
4. The flexural stiffness of the composite slim floor beams should be taken as that of the cracked sections.
5. Comparison with the test data for simply supported composite beams shows that the code method results in an acceptable level of the safety for degrees of shear connection less than the specified minimum.
6. In the dynamic analysis of reinforced concrete slabs stiffened with steel beams with deformable connection was expected that, the increment of the Eigen frequencies with the increment of the connector's stiffness is easily verified.
7. The reliability and the effectiveness of the procedure for continuous beams, which allows obtaining both global parameters such as rotations and deflections as well as quantities such as slips, curvature, interaction forces and rebar strains, can be extended also to semi continuous beams.

ACKNOWLEDGEMENT

The author wishes to express her sincere thanks to the Guide and Head of the civil engineering department, Dr.A.M. M. Pande sir, for his kind support & valuable guidance.

REFERENCE

1. Draft pr EN1994-1-1:2003, "Design of composite steel and concrete structures", Part 1.1: "General rules and rules for building" | 2. RMLawson and R Narayan. (1991), "Composite beam design to BS5950 part 3 and other methods" International conference on steel and aluminum structures ICSAS 91, Singapore, 22-24 may 1991. | 3. Jan W B Strak, (1991), "Design of composite steel-concrete structures according to Euro code 4", International conference on steel and aluminum structures ICSAS 91, Singapore,22-24 may 1991. | 4. I1-Sang Ahn, Methee Chiewanichakorn, Stuart S. Chen and Amjad J. Aref (2004), "Effective flange width provisions for composite steel bridges", Engineering structures 26 (2004) 1843-1851. | 5. Gerhard Haysville. (2008), "Euro code 4 Serviceability limit states of composite beams", Institute for steel and composite structures, university of Wuppertal, Germany. | 6. Gajanan M. Subnis, Ph.D., P.E "Hand book of composite construction engineering" | 7. Euro code 4: "Design of composite steel and concrete structures;" part 1.1: general rules for building. | 8. Swanson analysis Systems, ANSYS. Online manual, version 7.0 and theory reference. 7th ed. Swanson analysis Systems. |