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A Study on Composite Structure

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ABSTRACT

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. The composite sections using Steel encased with Concrete are economic, cost and time effective solution in major civil structures such as bridges and high rise buildings. 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. Also, it is evident that now-a-days, the composite sections using Steel encased with Concrete are economic, cost and time effective solution in major civil structures such as bridges and high rise buildings.

INTRODUCTION

Composite construction in India is very low compared to other country. In other country composite construction is growing rapidly. composite building have same thermal expansion, an perfect combination of strengths with the concrete being efficient in compression and the steel being efficient in tension.

Additionally, the concrete provides corrosion protection and thermal insulation to the steel at high temperatures. Finally, it can prevent slender steel sections from lateral-tensional buckling.

ELEMENT OF COMPOSITE STRUCTURE

Shear Connector

Shear connectors are used to join structural steel and concrete, and they are crucial for steel-concrete construction because they combine the compression strength of supported concrete slabs with supporting steel beams to increase structural stiffness and load carrying capability.

Shear connectors come in three basic categories: anchoring shear connectors, rigid shear connectors, and flexible shear connectors.

Composite Slab

A composite slab is a floor system made up of regular concrete that is permanently laid over a cold-formed steel deck, with the steel deck serving as both tension reinforcement during construction and a form work for the concrete at that time. The composite slab is made up of a profiled steel sheet and an upper concrete topping that are joined together at the end so that the steel-concrete interface can withstand horizontal shear force.

Composite Beam

A reinforced concrete slab is cast with shear connectors over a steel beam to create a steel concrete composite beam. Concrete slabs are simply positioned on top of and supported by steel beams in typical composite construction. Because there is no connection between the concrete and the steel beam, these two components behave independently when loads are applied. Steel beam and concrete slab function as a composite beam when a shear connector is installed between them, eliminating the slide between them.The composite beam can alternatively be built using precast or cast-in-place reinforced concrete slabs, profiled sheeting, and concrete topping.

Composite Column

A steel concrete composite column is a compression member made of either a hollow hot-rolled steel section filled with concrete or a partially concrete-encased hot-rolled steel section. It is typically utilised as a load- bearing element in a structure with a composite frame. In a composite column, the bond and friction between the steel and concrete would interact to resist the external loading. High-rise buildings can be constructed very quickly and efficiently by using composite columns, decking, and beams. Increased strength, stiffness, and buckling resistance are all benefits of composite columns. High bearing is provided by partially concrete encasing.

Advantage of Composite

There are many advantages associated with steel-concrete composite construction. Some of these are listed below:

- The most effective utilization of steel and concrete is achieved.
- Keeping the span and loading unaltered, a more economical steel section (in terms of depth and weight) is achievable in composite construction compared with conventional non-composite construction.
- As the depth of beam reduces, the construction depth reduces, resulting in enhanced headroom.
- Because of its larger stiffness, composite beams have less deflection than steel beams.
- Composite construction is amenable to ―fast-track‖ construction because of using rolled steel and pre-fabricated components, rather than case-in-situ concrete. Encased steel beam sections have improved fire resistance and corrosion. Considerable flexibility in design, pre-fabrication and construction scheduling in congested areas.

Objectives and Scope of the Project

Table 1 Design data for structure

S.NO	PARTICULARS	DIMENSION/SIZE/VALUE
1.	Model	3B+G+44
2.	Seismic Zone Factor	0.24 (Zone IV)
3.	Floor Height	4.2m
4.	Building Height	216m
5.	Earthquake Load	As per IS-1893-2016
6.	Type Of Soil	Type -II, Medium soil as per IS-1893
7.	Live Load	4 kN/ m2 as per IS : 875 (Part II)-1987
8.	Floor Finish	1.80kN/ m2
9.	Software Used	Etabs for static analysis,MS
10.	Importance Factor	1.2

DEAD LOAD AND LIVE LOAD

At typical Floor Level:-

Table 2 Dead Load and Live Load

Load Type	Intensity (kN/m2)
Load From Slab	3.75
Floor Finish	1.8
Total Dead Load(IS 875 (Part I)-1987)	5.75
Live Load(IS : 875 (Par t II)-1987)	4
Total Load	9.75
Total Factored Load	14.625

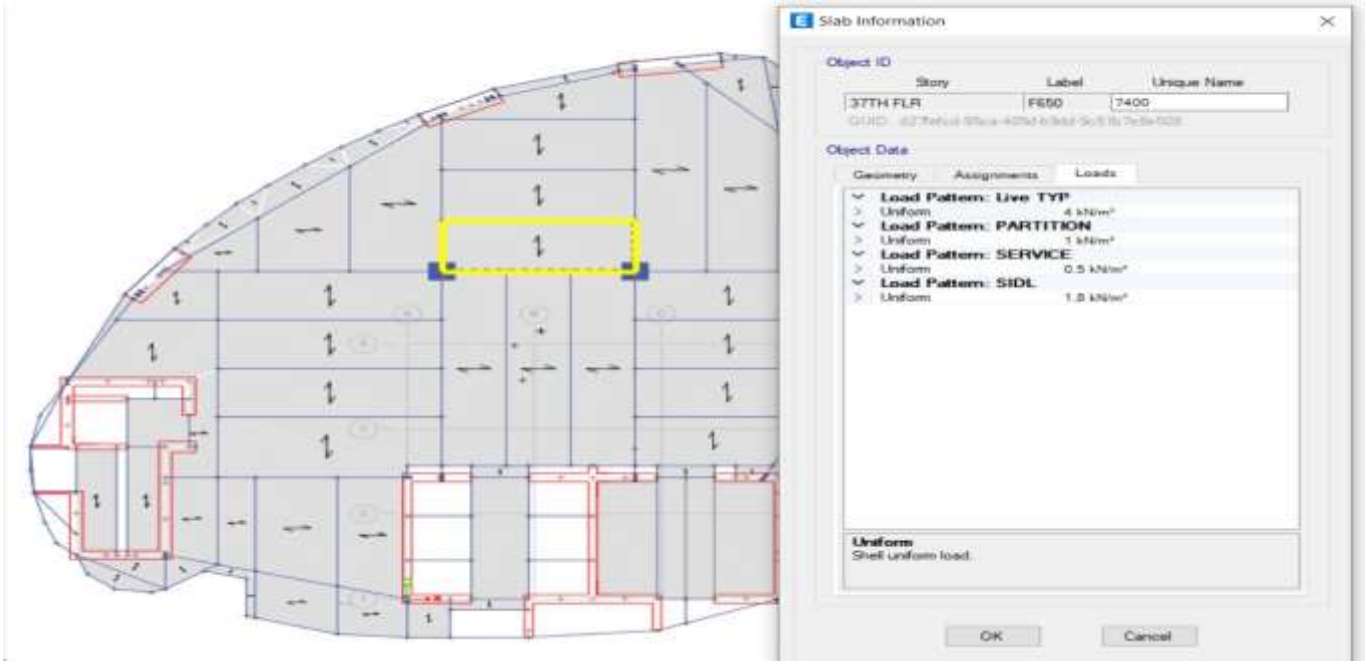

Figure 1 live load and dead load applied

Maximum Storey Drift:-

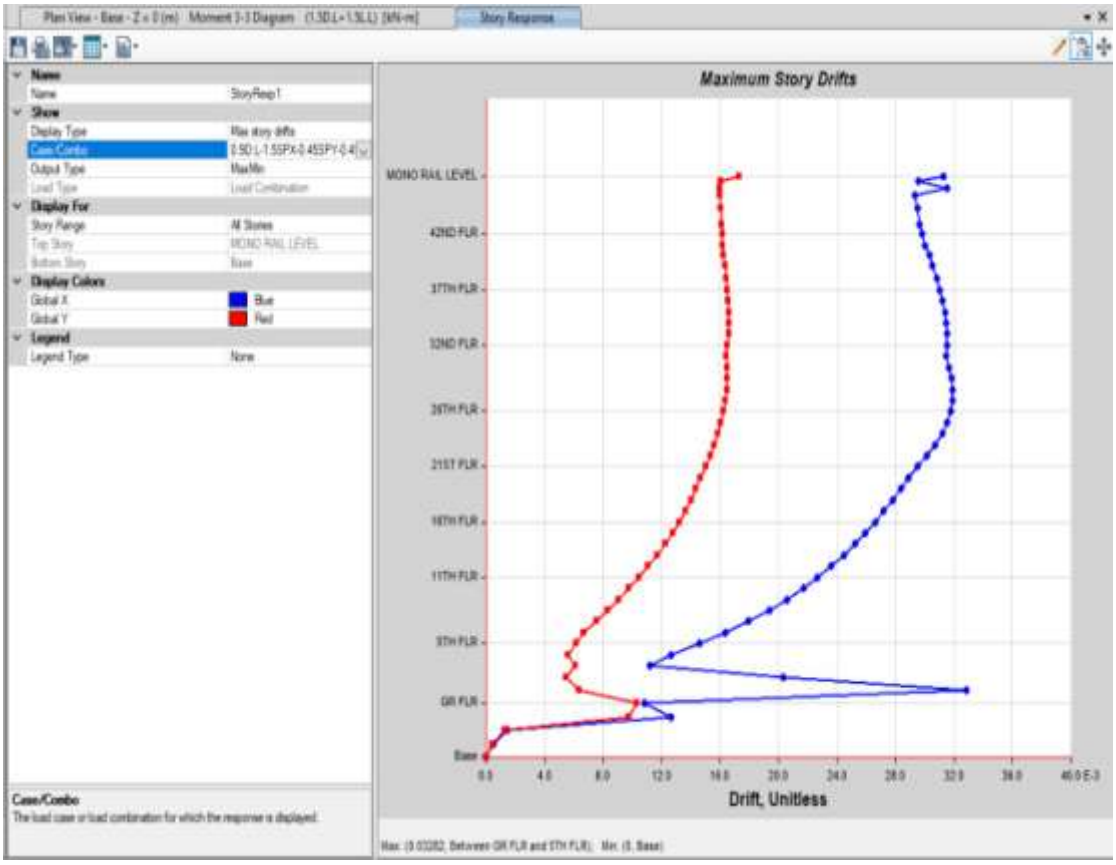

Figure 2 Story Drift

Elements of Composite Structure

Mechanical shear connectors are provided to transmit the horizontal shear between the steel beam and the concrete slab There are three main types of shear connectors;

- Rigid shear connectors,
- Flexible shear connectors
- Anchorage shears connectors.

Profiled Deck

Composite floors using profiled sheet decking have become very popular in the West for highrise buildings. Composite deck slabs are generally competitive where the concrete floor has to be completed quickly and where medium level of fire protection to steel work is sufficient.

CONCLUSION

1) The cost comparison reveals that steel-composite design structure is somewhat same as R.C.C. structure. But reduction in direct cost of steel-composite structure resulting from speedy erection will make steel-composite structure economically viable.
2) Further under earthquake consideration because of the inherent ductility characteristics, steel- concrete structure will perform than conventional R.C.C. structure.
3) Composite structures are more economical than that of R.C.C. structure. Composite structures are the best solution for high rise structure as compared to R.C.C. structure. Speedy construction facilitates quicker return on the invested capital and benefits in terms of rent.
4) To avoid the temperature increase in these steel elements, it is necessary to make them fire resistant using various insulators.
5) 5). Under earthquake consideration because of inherent ductility characteristics, steel-concrete composite structure perform better than a R.C.C structure.

REFERENCES

[1]. Anamika Tedia ,Dr.Savita Maru ―Cost, Analysis and Design of Steel-Concrete Composite Structure RCC Structure‖ IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) Jan. 2014.
[2]. Anish N. Shah, Dr. P.S. Pajgade ―Comparision Of R.C.C. And Comosite Multistoried Buildings‖ International Journal of Engineering Research and Applications (IJERA) April 2013.
[3]. Yogesh R. Suryavanshi , Prashant S. Patil ―Comparative Study on Analysis, Design and Cost of r.c.c. and steel-composite structure‖ International Journal of Engineering Research-Online 2015.
[4]. Josef Hegger, Professor Dr.-Ing ―High Performance Steel and High Performance Concrete in Composite Structures‖ American Society For Civil Engineers.
[5]. Dan Dubinia "Seismic response of composite structures including actual behaviour of beam to column joints" Composite Construction in Steel and Concrete IV © ASCE
[6]. Wolfgang Kurz, Christopher Kessler, "Evaluation of adhesive bonded steel concrete composite structures"Structures Congress © 2010 ASCE
[7]. Roberto Arroyo Matus "A High Seismic Performance Shear Connector For Composite Steel- Concrete Structures Subjected To Strong Earthquakes"
[8]. Shweta A. Wagh, Dr. U. P. Waghe "Comparative Study of R.C.C and Steel Concrete Composite Structures" Journal of Engineering Research and Applications April 2014
[9]. Eurocode 4 of Design of Composite Steel and Concrete Structures, Part 1.1: General Rules and Rules for Buildings, CEN, 1994.
[10]. Indian Standard Code of Practice for Composite Construction in Structural Steel and Concrete, IS 11384 -1985
[11]. Plain And Reinforced Concrete, Code Of Practice IS 456 : 2000
[12]. General Construction In Steel, Code Of Practice IS 800:2007
[13]. Structural use of steelwork in building - Code of practice for design of composite slabs with profiled steel sheeting BS 5950-4:1994.
[14]. Code of practice for design loads(Other than earthquake) For Building and Structures IS : 875 (Part 1 Dead Loads) 1987
[15]. Code of practice for design loads(Other than earthquake) For Building and Structures IS : 875 (Part II Imposed Loads) 1987

[16]. Code of practice for design loads(Other than earthquake) For Building and Structures IS : 875 (Part III Wind Loads) 1987
[17]. Structural use of steelwork in building Design in composite construction - Code of practice for design of simple and continuous composite beams BS 5950-3:1994.
[18]. Eurocode 4 Design of composite steel and concrete structures. General rules and rules for buildings BS EN 1994-1-1:2004
[19]. Handbook for structural Engineers ,Structural Steel Sections SP:6(1) – 1964(Revised in 2002)