STEEL–CONCRETE COMPOSITE CONSTRUCTION –- AN OVERVIEW

Steel-concrete composite construction is an advanced technology which combines the compressive strength of concrete with the tensile strength of steel to evolve an effective and economic structural system. Since concrete is strong is compression (weak in tension) and steel is strong in tension (weak in compression due to local buckling), composite action ensures the most suitable structural option in steel based structures. Over the years this specialized field of construction has become more and more popular in the western world and has developed into a multifaceted design and construction technique. Steel-concrete composite construction over the last few years is getting highly popularized in the Indian scenario, but is still limited to commercial structures like multiplexes, some industrial structures, a few multi-storied constructions and road bridges.

In this construction, structural steel work is typically used together with concrete; for example, steel beams with concrete floor slabs to attain composite action. This applies to buildings, road bridges, where concrete decks are normally preferred. Steel and concrete have almost the same thermal expansion apart from an ideal combination of strengths. Hence, these essentially different materials are completely compatible and complementary to each other. Ideally, structural elements made of structural steel and concrete can be used as composite structures so that they act together where concrete is made to resist the compressive stresses and steel takes the tensile stresses.

Composite Construction practice is still in a very nascent stage in India and so its effectiveness and applicability must be propagated for structures where fast track construction is of utmost importance. Tall structure, mainly in the building sectors are becoming popular in the urban habitat in the major metros. Most of these structures are being built as RCC construction. To promote usage of steel in tall steel structure in the building sector composite construction is all the more necessary. Various codes and specifications are being published both in the building as well as the infrastructure sector by the respective statutory authorities, to promote the use of composite construction.

The major bottleneck in the propagation of this technology in the country is non-availability of skilled worker, limitation of rolled sections available off the shelf etc. Also, misconception regarding corrosion of steel also affect the market share of composite construction. However, all the advantages of steel and concrete may be combined in the steel-concrete composite construction. It is felt that extensive application of steel intensive construction both in the form of purely steel construction as well as composite construction has a direct impact on economic factors including GDP (Gross Domestic Product) growth of a country. The extent to which the components of a building structure or a bridge will be of steel or reinforced concrete, or composite construction depends on the culture in the construction industry, availability of cost-effective design, code provisions and prevailing fire regulations.

In UK and USA, structures with steel-concrete composite elements experienced a huge surge in the 1980's, resulting in a profusion of new construction concepts and structural details. It is believed that steel-concrete composite construction received a further impetus with the widespread popularization of the concept of "fast track" design and construction

methodologies, which has been mostly developed in the USA. This has also resulted in adoption of a variety of structural systems and components tailored to match with the requirements of composite construction.

Advantages:

The basic advantages of steel-concrete composite construction may be summarized as follows:

1. Faster construction process, with maximum utilization of rolled / fabricated structural steel components and hence quick return of the invested capital.
2. Reinforced cement concrete (RCC) slab is in compression and steel joist/fabricated beam is in tension. Hence, most effective utilization of the materials can be achieved.
3. Advantages on life-cycle-cost analysis instead of initial and direct cost only.
4. Quality assurance of the steel material along with availability of proper paint system suiting to different corrosive environment. This facilitates faster and better quality-controlled construction of projects and better life of structure.
5. Ability to cover large column free area in buildings and longer span for bridges / flyovers leading to availability of more usable space.
6. Lesser overall dead weight ensuring better seismic resistance suited to overcome repeated earthquake loadings.
7. Lower dead weight also reduces cost of foundation.
8. Steel-concrete composite sections have higher stiffness than the corresponding steel sections, ensuring lesser bending stress and deflection and hence safer better serviceability.
9. Keeping span and loading unaltered, a lower structural steel section (having lesser depth and weight) can be provided in composite construction, compared to the section required for non-composite construction.
10. Reduced beam depth decreases the story height and consequently the cost of cladding in a building and lowers the cost of approach embankment in a flyover due to lower height requirement of embankment.
11. Reduced depth allows provision of lower cost for fire proofing of beam's exposed faces.
12. Cost of formwork is lower compared to RCC construction.
13. Cost of handling and transportation is minimized for using major part of the structure fabricated in the workshop.
14. Structural steel component has considerable scrap value at the end of useful life.
15. More use of steel as one of the main structural components ensures more durability, in addition to the fact that steel is fully recyclable, can be replaced easily and the material is more environment friendly.

Indira Paryavaran Bhawan

Handloom House

Institute for Steel Development and Growth has done a few live structures in composite, such as Handloom Complex at Janpath, New Delhi for Ministry of Textiles, one tower of Indira Paryavaran Bhawan for Ministry of Environment and its own office at Anandapur, Kolkata.

Arijit Guha
DGM (Civil & Structural)
Institute for Steel Development and Growth