

Exploring role of steel composite buildings to meet targets of Pradhan Mantri Awas Yojana .

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Abstract

Indian government's initiative 'Housing for all by 2022' is very ambitious considering the state of the art in constructional practices particularly in housing sector. To achieve set target of construction of about 20 million urban and 40 million rural residential units a paradigm shift is needed in way in which the housing construction operations are currently carried out. The situation is currently more alarming given the unmet demand of delivering completed houses in time which calls for adopting a constructional system that is faster and satisfy desired structural and aesthetical requirements. The initial stage of the planning and design involve critical decision regarding the selection of the construction material and technology which is important as it influence the quality of construction, construction time and cost. This research put forth various issues typically involves choosing steel against reinforced concrete which is currently the default option for the construction in Indian housing sector. It has been argued that use of steel composite buildings can rapidly deliver housing satisfying stringent environmental, quality and economic standards. Analysis indicated the suitability of this system in light of the time available to achieve the target of providing housing units within time available in hand.

Key words: Pradhan Mantri, Gauge, cold form, Awas .

1. Introduction

The Government of India is taking effort to bridge the gap between demand and supply of housing where Pradhan Mantri Awas Yojana (PMAY) is the recent development. The scheme was launched in June 2015 with a vision to cater for demand of about 20 million residential units by 2022.(PMAY)It scheme aims to provide adequate residential facilities equipped with water supply, sanitation, electricity in addition to make them affordable to people with median household income in light of housing affordability index.Here affordable housing

refers to the type of housing that satisfy the defined affordability criterion in context of size of the residential unit, income level of the family, or in terms of EMI against the annual income. Affordable housing is a multifaceted concept which aimed to provide adequate ownership and rental buildings with required infrastructure. It is suppose to stimulate pace of development with the use of advanced technology considering sustainability, disaster resistance and cost efficiency of built stock as prime criterion. (Gopalan & Venkataraman, 2015).

The achieve ambitious target set by Housing for all by year 2022 a number of initiatives have been taken by the government of India one of which is bringing private funding and transparency. Besides provision of the basic facilities like sanitation, water and electricity use of advanced and innovative technologies is advocated in addition to promoting concept of sustainable living parallel with UN agenda 2030 (Biermann, 2017). For promotion and transfer of potential advanced technology which is structurally sound, environment friendly, economically feasible and disaster resistant a comprehensive and integrated approach is needed (BMTPC).

The speed of delivery of housing units is alarmingly low as in four years after launching the Pradhan Mantri Awas Yojana only 20 per cent houses have been completed against the sanctioned number of houses for urban sector, while 52 per cent are under construction. Reportedly a small amount worth Rs.34,000 crore is received against sanctioned amount of Rs.1-lakh crore. As per the initial target of 12 crore residential units in urban India while 85.17 lakh had been got sanctioned out of which 26.49 Lakh units have been handed over to the beneficiaries.(Jadhav,2019)

Indian construction industry use conventional practice of R.C.C. structural system unlike our western counterparts. This system characterized by use of huge quantity of concrete as main constituent accounts for about a per capita consumption 1.5 tons per annum. Popularity of concrete as major material attributed to the easy availability its adaptability in terms of size and shape, low initial and maintenance costs and particularly no requirement of skilled labour. In presence of these advantages offered by concrete construction the environmental problems that this construction practice pose often ignored one of which is its less reuse and recycling potential. This phenomenon has resulted in millions of tons of R.C.C waste that is generated every year. Another aspect is the requirement of water for constructional operations which is alarming.

2. The Indian construction industry

The construction industry which is the second largest industry of the country after agriculture makes a significant contribution to the country's economy and generate provides employment at large scale. This sector accounts for steady growth of 8%-10% per annum which contribute to socio-economic development of the country. (Doloi, Iyer and Rentala, 2011) The growth of construction sector is coupled with numerous challenges in the presence of socio-economic stress chronic shortage of resources the scale of which is at an increase as observed in last few years (Jagtap, 2016). With the increase in demand in the field of construction, there come challenges in the area of performance, productivity, sustainability, labor and the total industrial growth. Environmental and economic concerns have prompted the building industry to research alternative building materials and methods. Research indicated that technology innovation result in revolutionary change in construction practice as compared to the traditional techniques. (Yu, 2008). The construction industry are in search of innovative constructional techniques in order to improvement of building quality, reducing the cost as well as minimization of construction time, safety and environment concerns in addition to achieve competitiveness.(Wong 2003)Steel framed buildings are in wide use in construction of commercial buildings with excellent in terms of quality and performance. Buildings with steel as structural material possess various environmental benefits one of which is capability for recycling making steel preferable for residential construction too.

3. Steel as a construction material: Global scenario

Steel is in large scale use in the North America as major structural material for more than 150 years. In European countries like Sweden and Finland it is a popular structural material for construction of single-family houses since the 1970s. Today it is recognized as one of the most durable structurally sound and economically viable material in construction sector. (Veljkovic, 2006). With due considerations to the numerous benefits offered by steel it currently captured residential construction market across Canada and the United States. Commonly used constructional systems comprised of light steel structural members with gypsum plasterboards and mineral wool in advanced counties like USA, Australia and Japan while it is gaining market in other European countries as well. Steel which was typically been associated in past with high-rise buildings and bridges now emerged as preferred material for housing construction (Veljkovic, 2006)

3.1 Steel as a construction material in Indian Context

India which is the world's 3rd largest producer of crude steel currently is projected to be at the 2nd place in near future.(Report by ministry of steel ,India ,2017) In light of large scale infrastructural development initiatives in India increased demand of steel is bound to be witnessed. Steel has been proved superior material for construction given its characteristic features that include high structural strength, speedy construction, enhanced space utilization, low energy consumption as well as aesthetic appeal as compared to reinforced concrete structure. Research comparing the embodied energy of constructed with steel and concrete with similar footprints demonstrated that steel structural system had less embodied primary energy than concrete. The embodied energy of concrete building found more significant than that of the steel in addition the impact of building materials was also affected to the operational energy of the building. (Yüksek, 2015)

Light gauge steel housing system is found suitable to achieve mass housing targets as compared to the conventional methods of construction considering the number of units to be constructed within short period. The mass production of steel structural members is coupled with economic viability in material procurement and consecutive reduction in price of residential unit. This phenomenon advocates use of Light gauge steel framing system preferable where housing demand is more. Although steel is recognized as one of the most promising materials for construction its use in India is at a premature stage particularly in housing sector. On one hand steel is used in industrial and commercial construction existence of residential buildings is exceptionally less. Steel is an important construction material in terms of sustainable development considering its recycling potential. The recycling capability of steel result in less waste generation as it can be reused in terms of producing new material reducing need for raw material in production process. (Kaziolas et al,2013) Steel manufactured from scrap steel can reduce carbon emission up to 50% which qualify steel as a green material (Björkman, 2014).Use of steel represents resource efficiency in building design and construction achieving technical and functional requirements aimed at improved lifetime performance. It also promotes ease for disassembly and deconstruction as well as building adaptability. (Gorgolewski ,2006).Use of pre-engineered roof make steel buildings lighter rendering them earthquake resistant promoting sustainable development.(Zende, Kulkarni and Hutagi 2013)Reportedly half of the global steel production that accounts for 700 million tons per year is recycled from scrap making it high ranked recycled material as compared to paper, aluminum, glass or plastic. This aspect indicate need for large scale use of steel, increasing market share with an optimistic outlook (Bateman 1997)Research

established that 83% of construction products made of steel are recycled, 14% are put for re-use while 3% sent for landfill on an average. The re-use of steel is preferred as it provides extended environmental benefits. This calls for conscious design and detailing in terms of planning facilitating assembly and disassembly both, geometry and configuration of the product as well as hierarchy of products based on connection methods and life cycle coordination. (Durmisevic 2003)

4. Advantages of Steel construction for housing sector

Steel construction is cost effective as the structural frame made of steel composite beams which need not to have formwork which is required for reinforced cement concrete construction (RCC) currently in use for construction of medium- high rise buildings in India. In steel composite columns axial forces and reactions are less as well as they can be used to induce more ductility in combination with concrete that offers corrosion and fire protection. Composite structures are light weight offering them more seismic resistance as compared to conventional RCC construction. The constructional operation predominantly involve assembly of structural members that do not require curing as it in case of RCC construction thus result in substantially more speed of construction.(Zaveri , Gadhiya and Dhameliya, 2016) Research established that steel framed structures are most light weight structures which proved to be economical satisfying various cost models with high productivity.(Proverbs and 2001) Given the need to provide accommodation to larger population multi storied housing units are preferred where because of the less usable space allocation demands architectural optimization. (Gero, J. S. 1975). The sleek structural layout of steel buildings can cater for the problem of space crunch particularly in mass housing requirement in urban areas under PMAY.

Currently RCC framed buildings are perceived as best option for construction in housing sector in terms of availability of technical know-how, ease in construction and cost involved. It has been observed that in many housing projects pre-cast RCC construction is in growing use. Research indicated steel composite structures are more economical than that of R.C.C. structure in light of speedy construction which facilitates faster return on the capital investment. (Dabhade, Hedao, Gupta, Ronghe, 2009)

5. Light gauge steel frame system

Technological innovations resulted in development of light gauge steel framing system which possesses numerous advantages for construction in terms of improved strength, stability, and safety. This advanced framing system can be used in residential, commercial, and industrial buildings with up to three floors. It is the combination of Prefabricated MS structures with Rapid Building System walls. The structural elements like columns, beams are made of prefabricated mild steel. For floor slabs hollow core slabs or Deck sheet with concrete is commonly used. The infill walls constructed with light gauge steel frames stuffed with Insulation and sandwich with Fibre cement boards. Steel sections are formed at room temperature and referred as cold formed steel sections. The process of manufacturing includes passing thin sheets of steel through a series of rollers; with each roller slightly change the shape of the steel frame. The size of cold form sections is 1 to 3 mm for structural application while it is kept 1 to 2 mm for non-structural applications. Various thicknesses and gauge as well shapes are used to manufacture structural members of required structural strength. Many a times bends and folds are provided in the cross section of the member in order to make them stiff and strong for improved structural performance.

Commonly used gauge or thickness of steel sheet ranges from 10 to 25 where by convention the thinner sheet is assigned with higher gauge number. Exterior load bearing studs are made with 18 or 20 gauge steel which is strong enough to sustain the loads imposed by external environment. For interior walls 25-gauge steel is used. Steel sections are zinc galvanized to check rusting which may happen during storage, construction in order to avoid damage and loss of strength.(Bateman 1997). Steel components generate minimal waste and all light-gauge steel construction materials are 100% recyclable. Light gauge steel members are stronger than conventional materials and can facilitate longer spans. Steel can be shaped into required form in addition to offer the opportunity for required modifications. This system results in an increased carpet area given the less thick partition walls which render this technique desirable for housing units to be constructed under PMAY in urban areas.

6. Conclusion

Indian housing sector need to construct large number of housing unit to cater for demand by year 2022 as per vision of PMAY. Considering the current status of progress under this scheme which is far behind the set targets a shift in construction technology is needed. This research established that use of light gauge steel is capable to provide an apt solution as it can

save up to 30% of construction time. Use of steel in housing sector is stressed as it has been a versatile material that offers numerous benefits that include structural strength, recyclability, reusability, endurance, compliance and affordability. Considering the continuously growing need of housing stock steel framed buildings is an affordable solution. Less material use and less transportation will lead to overall low cost houses. Recycling and reuse capability of steel components make this system of construction environment friendly. The technology transfer from concrete to steel will give a great momentum in execution of PMAY to achieve its ultimate aim.

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