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COMPARATIVE ANALYSIS BETWEEN RC CONSTRUCTION AND LIGHTWEIGHT STEEL CONSTRUCTION

Abstract. The construction of lightweight steel has been remarkable in multiple applications including residential, commercial and industrial buildings. Many studies focus on the advantages of building lightweight from several aspects. This article highlights a comparative study of the construction of lightweight steel and construction by reinforced concrete in technical and economic aspects such as the weight of the building, construction time and construction conditions. In this article, the construction of lightweight steel appears to be the big difference in the weight of the building compared with the construction of the reinforced concrete and also by construction duration, which the construction needs from start to finish. It is also illustrated that direct and non-direct cost for light-weight steel construction is less than the cost of construction with reinforced concrete.

Keywords: reinforced concrete, lightweight steel, Cost life cycle, construction duration

Introduction:

With growing population growth and development movement in many countries of the world increases the need for new building materials and new building systems to keep up with this acceleration in urban growth and modern building requirements compatible with the requirements of sustainable development and modern technology in construction. Recently the construction of lightweight steel as one of these alternatives that began to be widely used in many construction applications. Multiple criteria set out and continuing this construction systems such
as the total cost, rapid construction and consumption of raw materials and their ability to achieve engineering specifications for construction. Despite the multiplicity of construction and building materials, the use of reinforced concrete and steel is still in the construction sector because the raw materials that make up, steel, cement, aggregates and water are available in almost every country. However, this does not prevent new building materials and construction systems and its use in addition to traditional construction systems and materials. The lack of knowledge and experience in the advantages of lightweight may be delayed to be used in some countries in the world widely, including Azerbaijan. However, global market indicators ensures that this type of construction is going on a continuous growing of the world. The reason for this is due to the advantages provided by the construction of lightweight steel such as ease of installation, modification, demolition and flexibility in adjusting architectural designs, lack of use of raw materials, speed of implementation and high ratio of strength to weight and economic age. This explains the growing demand in the global market for construction on this type of construction. This article reviews the comparison between the construction of reinforced concrete and constructed with lightweight steel from several aspects as follows:

1-Architectural Flexibility:

Due to the characteristics of lightweight steel and its high strength compared to weight and size, the steel elements are always slimmer and lighter of concrete elements, which provides a greater actual space and gives greater access to wider rooms. This enhances the improvement of the functions of space and flexibility in design and architectural planning. Tolga ÇELIK, Saeed KAMALI studied a case of a villa in the same area in two cases using reinforced concrete and again using lightweight steel and found that the actual area of the villa in the case of reinforced concrete is less than 2.6% compared to a lightweight steel. Moreover, steel walls can be changed easily and this makes the building structure more adjustable. In addition, the installation of future construction elements can be deconstructed and changing architectural design or adding key structural elements or vertically to expand the area and add new floors and thus makes lightweight steel buildings
adaptable to future changes. In contrast, the ability to modify and expand concrete buildings is less. On the other hand, electricity, heating, insulation and air conditioning requires damaging in construction and structural elements. While electricity and air conditioning take in account during manufacturing, and this factor also affects the cost compared to buildings with the reinforced concrete.

2 - The weight of the building:

Sirikci, I. (2006) Studied a specific building found that the dead load in the traditional steel building was 718 tons of steel while and for the same It is estimated that the dead load of the same building but using lightweight steel is 10% of the weight of the concrete building. The following shape illustrates the comparison of dead loads between the concrete, steel and lightweight steel.

![Fig. 1. Dead load in reinforced concrete, steel and lightweight steel building](image)

And in another study by Tolga ÇELIK, Saeed KAMALI designing and building two floors once using the reinforced concrete and again using the lightweight steel where the building was in the case of reinforced concrete 151.7 while the same villa was the same in the case of lightweight steel 16.9 .As is known, the minimization of the dead load of the building reduces the size of the columns and the foundation thus it reduces the impact of earthquakes and therefore they will also reduce the consumption of raw materials and the cost of the building.
2- Energy efficiency:

One of the most important criteria for building assessment is its ability to maintain high energy efficiency within the building through insulation and provision of air conditioning equipment and maintenance of the cover of the heat leakage. It is although the rate of delivery and transfer of steel for heat is higher than the reinforced concrete, macro-insulation in lightweight steel buildings is not only on the structure, but has been developed and systems areolation in this type of construction managed to increase the insulation compared to the reinforced concrete.

3. Cost life cycle

The cost of buildings is distributed between the initial cost, implementation, operating, maintenance and salvage value, taking the time value of money into account to identify cash flow of cost.

The initial cost involves the raw material which generally less in case of lightweight construction than reinforced concrete. In addition, the actual area of the concrete buildings is less than a lightweight steel building due to thin thickness for steel walls.

Study by Özlem Eren show that energy consumption is 75.1 compared to concrete buildings which decrease the operation cost. In regard to the cost of maintenance is less in case of lightweight steel construction because steel is not affected by nature factors and do not dry and shrink over time. It also can be recycled, deconstructed and installed again in other buildings and therefore the end value of building in this case is plus value. While funds are spent for demolition and removing a concrete building with less recycling. Furthermore, changes in weather conditions do not occur on lightweight steel construction activities while high or low heat affect reinforced concrete works, which leads to additional costs in these circumstances as a result of delayed work. Because the possibility of lagging on the timetable in the construction of lightweight steel, its use instead of reinforced concrete provides 2 to 3% of the total cost as it sees. The construction of lightweight steel provides an estimated 22% compared to the reinforced concrete for the same villa composed of two floors done by the study which did by Tolga ÇELIK, Saeed KAMALI.
4- Quality Management:

Since the structural elements of the lightweight steel building structure are formed in the factory, and their dimensions and shapes are determined by the computer, and the implementation is through assembling these elements and forming them on site, the quality of the elements and implementation is higher compared to the buildings of reinforced concrete, which depends mainly on the quality of performance and labor work on the site and site conditions and control Engineers. Therefore, building with lightweight steel is considered to be of higher quality than building with reinforced concrete.

6- The duration of construction:

Sirikci, I. (2006) Estimated that the construction of concrete buildings longer three times a minimum compared with lightweight steel construction. The reason for this is due to the structural elements in the lightweight steel are prepared in the factory and do not need to build and wait after casting as in the reinforced concrete. In a two-story study, the necessary period for building concrete structure 79 compared to 23 days in the case of lightweight steel at a rate of 8 hours a day and five days a week. In addition, the possibility of determining the duration of construction and timetable with lightweight steel is clearer and more accurate and this is reflected on the capacity to determine the cost more accurately. While the opportunities for the construction in the constructor are greater.

Result and conclusion:

The following figure illustrates the most important results that can be estimated for the net possible area and the weight of building and the duration of construction and cost difference.

It is shown in the previous form that in the case of construction of the reinforced concrete so that the net building area was less than 2.6% and the total mass of the building is greater than 9 times and the total cost is less than. The duration of construction is less than 70.9% compared to a lightweight steel construction. In addition to the lightweight steel construction of a flexible and quality in isolation and ease of finishes for the building. In the outcome, the construction of lightweight steel is more effective than the reinforced concrete for short and medium buildings,
but this alternative needs to be broader for several varieties of buildings to determine the exact limits where more effective.

Fig. 2. *General comparison between reinforced concrete and lightweight steel building*

However, through previous results, the construction of lightweight steel is clearly encouraged to grow up this sector in the global construction market and is expected to see clear growth in the next years.

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