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Analysis of Steel Construction, Construction of a Canopy in the Function of a Facility for Light Industry

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A B S T R A C T

Steel is a widely used material in every industry because of its superior strength, versatility, and durability. The properties of steel, including its high tensile strength, ductility, and ability to withstand harsh environmental conditions, make it an ideal choice for a variety of structural applications. Making steel involves extracting iron from iron ore and then refining it to remove impurities and increase its strength. The steel is then formed into various shapes and sizes through a process known as forging. This can involve cutting, welding, bending, and shaping to create the desired structure. Steel structures are applied in various sectors, including residential, commercial, industrial, and infrastructure projects. In the housing sector, steel is mostly used in the construction of tall buildings, residential houses, and prefabricated houses. Its strength and lightweight nature allow for taller and more durable structures. In the commercial sector, steel structures are often used for office buildings.

Keywords: steel, material, properties, obtaining, steel structures.

1. Introduction

Steel is an alloy of iron with a different percentage of carbon. Adding other elements to iron gives different types of alloys. Adding chromium, nickel, and molybdenum to carbon steel (more than 10%) gives us stainless steel known as prochrome.

Today, steel represents the most numerous and commonly used group of metals. Various types of steel are mostly used in the machine industry, construction, agricultural machinery representation, mining, chemistry, and energy. Today, several thousand different types of steel are known in the world, obtained by a suitable combination of the content of coal and alloying elements with various properties.

1.1 Division of steels

Steels can be divided according to purpose; chemical composition; structure; method of obtaining; quality; shape; and condition of the semi-finished product. According to their purpose, they are divided into: Structural steels; tool steels; steels with special properties.

2. Structural steels

Structural steels are required to have good mechanical properties, good processing by cutting, deformation (forging, rolling, drawing, and pressing), good weldability, and low cost. According to their strength (yield stress), these steels are divided into four groups:

- low-strength steels, Re < 250 MPa,
- medium-strength steels, 250 MPa< Re< 750 MPa,
- high-strength steels, 750 MPa< Re< 1550 MPa,
- ultra-high-strength steels, Re >1550 MPa.

Structural steels are used for steel structures or structural elements in the engineering industry, such as bridges, ships, boilers, pipelines, and similar structures.

2.1 Properties of steel structures

The properties of steel structures derive from the properties of steel. The most important mechanical properties of steel are:

- Stretching limit,
- Tear strength,
- Elongation at break,
- Contraction,
- Tenacity,
- Hardness.

2.2 Advantages and disadvantages of steel structures

Steel structures have their advantages and disadvantages.

The advantages of steel structures are:

- high strength,
- high modulus of elasticity and
- properties of isotropy.

The disadvantages of steel structures are:

- corrosion resistance and
- resistance to high temperatures.

3. Experimental part

In the framework of this paper, an analysis of steel construction, that is, the construction of a canopy in the function of a facility for light industry for service services and warehouses, has been made. Steel construction is obtained by cutting, shaping, and assembling different pieces of steel to form a structure. The craftsmanship allows for customization and precision construction, making it a popular choice for steel construction. The object consists of a ground floor. The floor slab on the ground floor is raised by 1.20m from the elevation of the ground with a ramp, which is existing and which the existing building has.

The canopy is made to function with an existing building. The construction is made of metal angular columns. The roof structure is also made of metal elements, which are covered with a sandwich sheet and an inner layer of self-extinguishing polyurethane foam up to d = 5cm. The attic of the building is made with a sandwich wall panel. The canopy occupies a space of 580.80m2.

The construction is made of metal box profiles 200/200/5. The pillars are connected to the foundations with a metal anchor plate with d = 50/50 mm, which is placed on the reinforced concrete plinth. The roof construction is made of metal construction, i.e., metal IPE supports (IPE 300) and metal grid supports (R-supports), on which sandwich sheet plasticized panels with d = 5cm are placed, made of lower and upper galvanized plasticized sheets, and an inner layer of self-extinguishing polyurethane foam. The attic is made of a metal substructure of closed-box steel profiles 80/60/3. (Figure 1, 2,)

a b

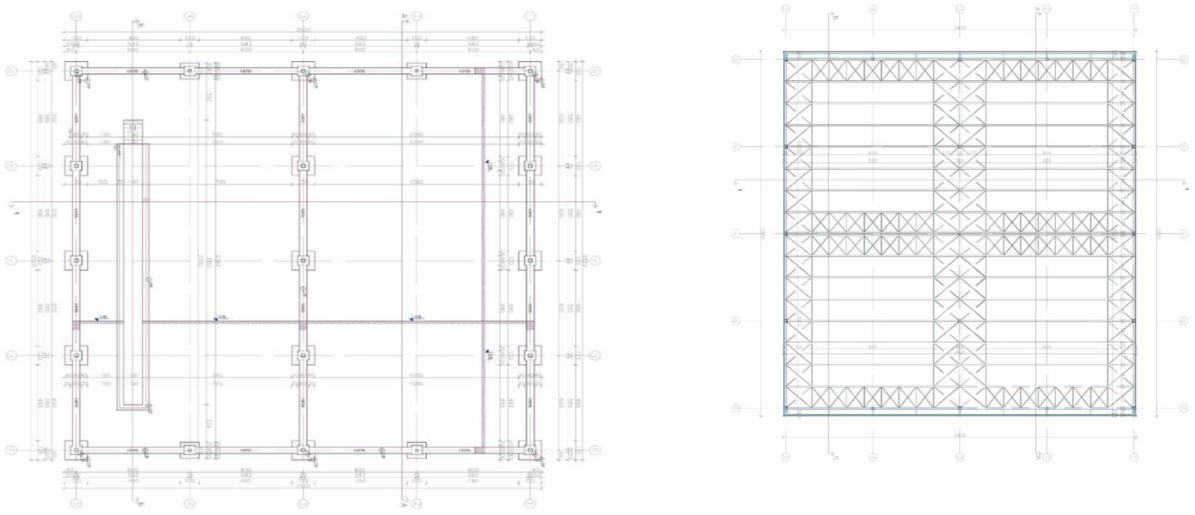

Fig. 1 - (a) floor processing; (b) foundation of roof construction.

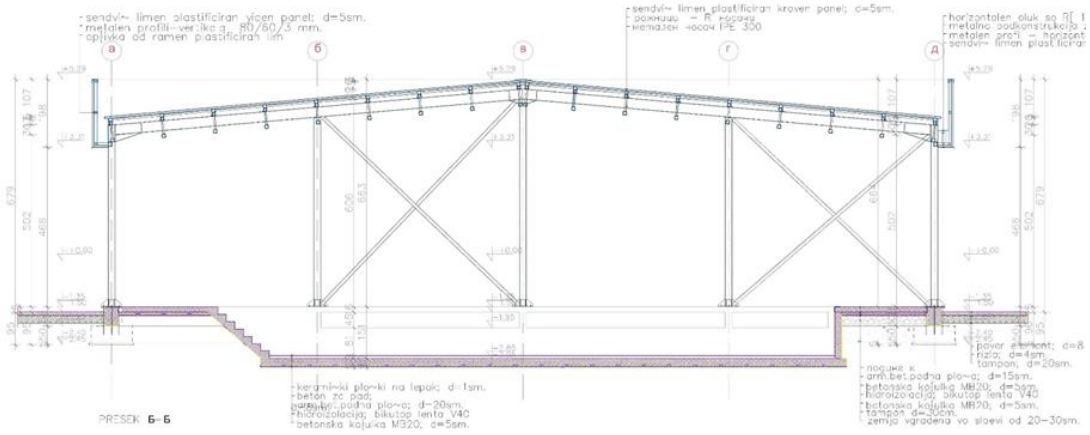

Fig.2 Section

3.1 The manufacturing and assembly process

The process of production and installation of a steel structure includes several steps:

1. *Design*: The structure is designed according to the specific requirements and intended use. This includes determining the dimensions, load capacity, and other necessary specifications. Steel is selected based on structural calculations.
2. *Forming*: The selected steel is cut, formed, and shaped into the desired structural components. This may include processes such as cutting, bending, welding, drilling, and surface treatment.
3. *Transportation and Shipping*: Once the steel components are fabricated, they are usually transported to the construction site.
4. *Site Preparation*: The construction site is prepared, which may include clearing the site, leveling the ground, and laying any necessary foundations or footings. (Figure 3).

Fig.3 Site Preparation

5. *Assembling the steel components*: They are then assembled and erected on site in accordance with the design plans. This may include the use of cranes, lifts, and other equipment to place and secure the structural elements. (Figure 4).

Fig.4 Assembling the steel components.

6. *Finishing work:* After the steel structure is assembled, finishing work such as painting, insulation, and the installation of electrical and plumbing systems is carried out. (Figure 5).

Fig 5. Finishing works

7. *Quality Control and Inspection:* Quality control and inspections are conducted throughout the manufacturing and installation process to ensure that the steel structure meets the required standards and specifications.
8. Commissioning: Once the steel structure is complete, it can undergo commissioning, which involves testing and verifying its functionality, safety, and regulatory compliance. It is important to note that the specific process may vary depending on the size, complexity, and intended use of the steel structure.

4. Results

The resulting steel structure has several characteristics, namely:

- The resulting steel structure has a long life because it is resistant to corrosion, fire, etc. Steel has excellent properties for fire resistance because it does not burn and does not contribute to the spread of fire. This characteristic makes it a safer choice for construction. It also has good strength; that is, it does not warp, rot, or crack easily.
- Ability to a high degree of design flexibility, which enables innovative and unique architectural design.
- Steel structures are economical compared to other building materials. They require less foundation work, can be manufactured in a controlled environment, and have shorter construction times, resulting in reduced labor and overall project costs.
- The construction has a low carbon footprint as it requires fewer materials and creates less waste during construction compared to other building materials.
- It is lighter in weight compared to other building materials, such as concrete. This reduces the foundation requirement and allows greater flexibility in design and construction. It is designed to be stable and resistant to external forces such as wind, earthquakes, and heavy snow. It also has a high load capacity and is relatively light, providing stability and safety.

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References

Murray, GT (1997). *Handbook of Materials Selection for Engineering Applications Mechanical Engineering*, Marcel Dekker, Inc. California Polytechnic State University San Luis Obispo, California.

J.W.Martin. (2006). *Materials for engineering*, (3rd ed.), Woodhead Publishing Limited.

James F. Shackelford. (2005). *Introduction to MATERIALS SCIENCE FOR ENGINEERS*, (8th ed). Pearson, University of California, Davis.

Lawrence Martin, John Purkiss. (2007). *Structural Design of Steelwork to EN 1993 and EN 1994*. (3rd ed.). Routledge.

Buick Davison, Graham W. Owens. (2003). *Steel Designers' Manual*. (6th ed.), Blackwell Publishing.

Wei-Wen Yu, Roger A. LaBoube, Helen Chen,.(2019). *Cold-Formed Steel Design*. (5th ed.).

Robert Ratay. (2009). *Forensic Structural Engineering*. (2nd ed.). McGraw Hill.

Mark Lawson, Peter Trebilcock. (2004). *Architectural Design in Steel*, (1st ed.)