https://dx.doi.org/10.22161/ijaers.611.6 *ISSN: 2349-6495(P) | 2456-1908(O)*

Comparative Analysis of Metal Structure and Reinforced Concrete, Comparing the Systems for a Commercial Enterprise

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Abstract**—***This work brings the proposal of a comparative analysis of metal structure and reinforced concrete, comparing System for a commercial development that would be metal structure and reinforced concrete structure, from the beginning comes to the history of concrete and its origin after that of steel. Preparing the reader for what is most relevant in this investigation, which is the research proposal of how it was performed, which vertically deals with it. Reinforced concrete and metal structure have their advantages following construction, both are of great use, if they stop to find out both structures are present in the daily life of humans. So, comes to the curiosity to know, which structure is most useful and economical when it comes to construction? The answer to this question lies in the conclusion of this research.*
Keywords**—***Reinforced concrete; Metal structure; Construction.*

I. INTRODUCTION

Over the years the human being, looking for new alternatives to improve life, leaving their cave dwellings, then houses made of wood and stone. By linking with greda, lime and among other ligands, the Egyptians and Romans, along with other peoples, began the construction of pyramids and temples. These constructions are still addressed today.

Thus, man has been benefiting from the development of the means of apparatus within the construction industry, always seeking a new innovation within the construction sector and outside it.

Therefore, the following work has been addressing two relevant creations of the human mind, which greatly help the development of the search for ways to build, thus leading to the creation of concrete and steel. Since concrete due to its strength has become an object significant for human progress, it can be observed that it is present in everyday life. In concrete sidewalks, hard paved streets, buildings and dwellings, the concrete of the following extremely important in the development of civilization.

The steel to complement in construction, because besides being very versatile is also the most notable when talking about metal alloys conceptualized by man. For this reason, the most regular aspect of ferrous metals is steel, cast iron and wrought iron, with steel being the most respectable of the three today.

Finally, throughout this work will be presented a comparative analysis of these two structures, reinforced concrete and steel structure, as they play an extremely important role for the development of civilization.

II. THEORETICAL REFERENCE

2.1 History of reinforced concrete

The ancestors used stone as an object to build their houses and as the human mind developed, the material began to be used in fortification buildings, leading to overcome river gaps or to develop temples used for worship of their Gods.

From this, (5) it is clear to man that the stone is an excellent construction tool, as they observed that it was durable and capable of withstanding this when used with pillars.

The Romans who pioneered the construction of stone arched bridges, when it was not possible to use this art using beams to overtake wider spans, used a stratagem as arches to study the pieces that would work in compression (5).

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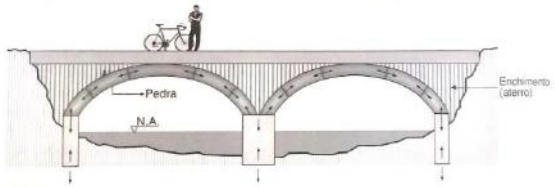

Fig.1 - Study of the stone in compression
Source: Botelho (2015)

Benefits of Reinforced Concrete

When we talk about reinforced concrete, analyzing it with the other materials of civil construction, they follow from their proper characteristics and consist of the inherent contingencies in which the works are discussed (8).

- Building economy
- Resistance to environmental chemical aggression
- Resistance to physical aggression of the environment

Steel

Steel is very eclectic and is the most important alloy known to man. (12) As such, the first steel material operated within the building was cast iron, which in the mid-1780s and 1820s when arched or truss bridges were made, with properties in cast iron working in compression (11).

Wrought iron came to be used in eighteenth century outcomes in bar chains, forming the supporting elements of suspension bridges. A relevant example showing the use of wrought iron bars is the Menai Suspension Bridge in Wales, construction was made around 1819-1826 (11).

The steelmaking process shows how the production of steel is carried out, its production is derived from iron ore, by conversion of pig iron, or semi-integrated, in which steel is obtained through scrap. Figure 2 brings this process in a more visual way that is easy to understand (7).

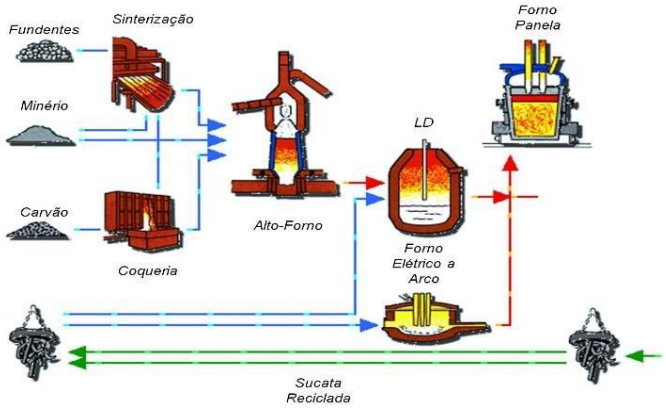

Fig.2 - Steelmaking Process
Source: http://aciarianews.blogspot.com/2012/12/forno-eletrico-arco-fea.html

Advantages of Structural Steel

- Freedom in architectural design;
- Larger floor area;
- Flexibility;
- Compatibility with other materials;
- Shorter lead time;
- Rationalization of materials and labor;
- Load relief on foundations;
- Quality assurance;
- Anticipation of the gain;
- Organization of the construction site;
- Constructive accuracy;
- Recyclability;
- Preservation of the environment.

III. METHODOLOGY

For the following work the quantitative method was used in order to bring two assumptions that, from interference, a third, called conclusion, is drawn. Thus it is important to note that the following reasoning does not offer new knowledge. But a comparative analysis of two applications. The exploration outline and the information extraction tool succeeded in a documentary way, as (5) documentary research is performed through origins by about tables of results, opinions, software outcomes, minutes, presentation, projects and unpublished works of any kind. nature. Document analysis offers a significant method within the context of this research.

This work compares an analysis focused on building systems of a commercial enterprise. Figure 3 below shows the flowchart of how the research was carried out for its construction.

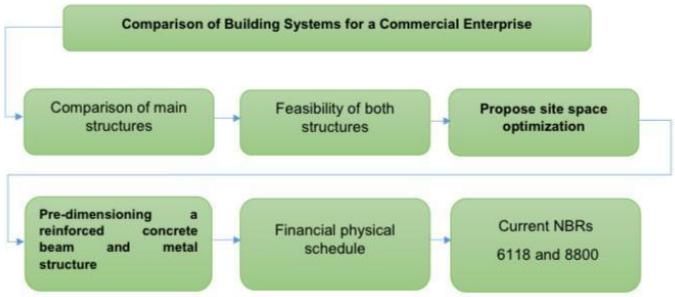

Fig.3 – Flowchart
Source: Own authorship, 2019

According to the various researches and readings that speak of reinforced concrete and metallic structure, from authors known in the following. When it comes to building, the first step to good project execution is planning. Because with all that has been seen, for good

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planning the choice of the project is fundamental for success in choosing which structure will meet the needs of the project, since the chosen method will greatly influence the physical schedule, cost and other factors. (9).

In the course of the investigation that was carried out to analyze the reinforced concrete and metallic structures, it can be verified that both are of great relevance, however as it was said before a planning, that demonstrates or that can give an assumption of which structure would be left. more feasible for the construction of the project, since the choice of the structure goes far beyond the price, because the structure that seems to be more feasible in one place may not always be executed in the same proportion in another, for example some interiors of the In the state of Amazonas, due to its difficult to reach logistics, the cost of the material becomes much more expensive.

However, what worries the most about civil construction is to avoid the generation of waste and waste, making the profit of the work even higher and the environmental impacts will be increasingly minimized. Thus, having notions of the land also enters the subject of planning, because where the construction will be made is fundamental to reduce the cost of the work. This is because, with the arrival of the material in the construction site, it is necessary to have temporary facilities such as material storage, housing, bathroom and office. The image in figure 4 shows the example of how the site is optimized in a reinforced concrete construction.

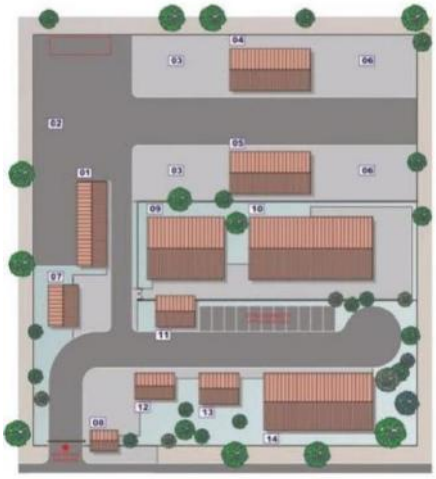


Fig.4 - Construction Site Optimization

Autoria: Naback, 2008

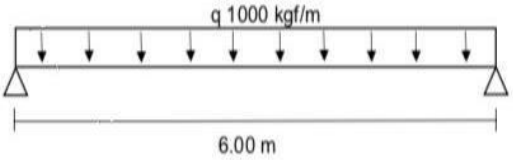
Legend of Figure 4	
1. Warehouse and Tooling 2. Yard or Warehouse Truck 3. Raw Material Stock Area 4 .Central Frame 5. Shape Center 6. Areas for Benefited Material Stock 7. Concrete and Soil Laboratory	8. Ordinance 9. Toilet and changing room 10. Refectory 11. Surveillance Office 12. Pointing 13. Medical Clinic and Safety at Work 14. Technical and Administrative Office

To be more agile the flow and logistics of the construction site it is important to evaluate the conditions of the construction site and how the materials will be transported. Proper handling of equipment for safe, fast movement of loads and workers is important for safety. In the analysis carried out from the construction site, when it comes to the small space, the metal structures are advantageous because the steel parts have already reached the construction site, which makes the work free of improvisations that only makes costs increase (10).

To get a sense of the cost dimension of a metal frame and a reinforced concrete frame, comes the pre-dimensioning of a two-girder beam of both frames.

Pre-dimensioning reinforced concrete beam

The following beam is supported, is 6 meters long.



In beams, the initial element to be dimensioned is the height, and this is given in relation to the span length. Which looks like this:

$$\frac{L}{10}$$

With the entered values you get the value of the beam height:

$$\frac{600}{10} = 60$$

So with the pre-sizing of:

$$20 \times 60$$

Pre-dimensioning metal-supported bi-beam

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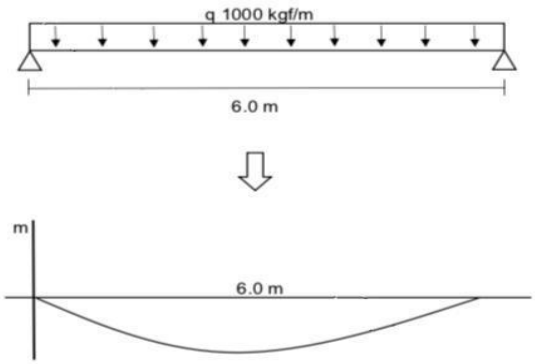
Pre-dimension a 6 m free span beam of a metal structure.



Solution:

$$Mmáx = \frac{P \times L^2}{8} = \frac{0{,}10 \times 600^2}{8} = 4500\ kN\ cm$$

Bending moment value My = 4500 x 1,55 = 6975 kN cm

Physical and Financial Schedule

Evaluating concrete using an example as a part

Table 1 – Price

Financial Physical Schedule

Total Cost of Reinforced Concrete Beam

DESCRIPTION	AMOUNT	UNIT COST	TOTAL COST
Steel CA-50	16,5 kg	R$ 4,00	R$ 66,00
Steel CA-60	2,90 kg	R$ 5,30	R$ 15,37
Annealed wire	1,00 kg	R$ 10,00	R$ 10,00
Concrete 25 Mpa	0,48 m³	R$ 375,05	R$ 180,02
Forms, E= 18 mm	6,00 m²	R$ 45,72	R$ 274,32
		Total cost	R$ 545,71

Source: Own authorship

Values used for execution and metal beam

Table 2 - Price of the metal beam

Financial physical schedule

Total cost of the beam in metal

Description	Quantity (m)	Nominal Mass (kg/m)	Weight (kg)	Cost Unitary	Cost Total
Type "H" Profile, Laminated steel, W 310 X 38,7	6,00	38,7	232,2	4,69	R$ 1.089,18
				Total cost	R$ 1.089,180

Source: Own authorship

(9) Work schedule results from the adequate sizing of the work teams, as well as the times and the sequence of execution. Thus, the Figure 6 shows the demonstration of the Bar Schedule, done in Ms Project.

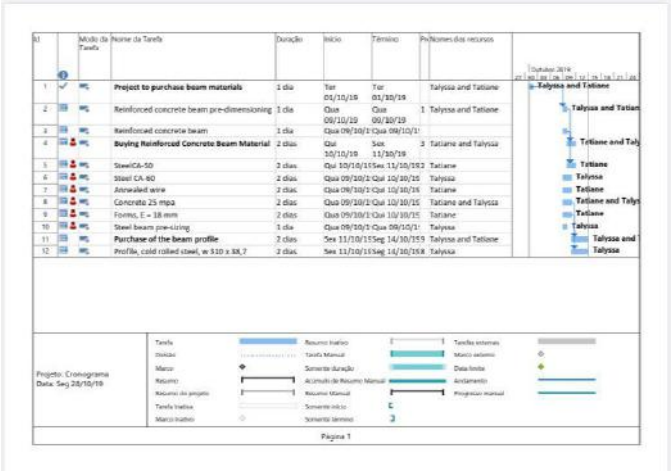


Fig.6 - Bar schedule

Source: Own authorship, 2019

IV. CONCLUSION

The following research was carried out in order to study two premises, which start from reinforced concrete and metallic structure. In order to bring an analysis of them during the investigation, it can be seen that both are of great relevance, however, when the subject is construction has another important point, to highlight that is called planning.

Planning is a key part in choosing the best structure to use, as as research progresses one can see how much is needed. This is because it is not enough just to build, have to be aware of other factors, such as construction site, collaborators, initial capital for construction, the project to be executed, materials, others and finally the most viable choice that will meet the requirements of the client.

At the end of this paper it is concluded that it is not a smart view to report that the reinforced concrete structure is much more accurate than the steel structure, as both have many advantages, but what will determine which is the best for a given construction is the planning, because it brings all the terrain, cost and time analysis so on.

Further exploring the reinforced concrete structure and metal structure, comes the idea of pre-sizing a beam of each structure, to get a sense of how much would be the cost of both, thus obtaining the result that the beam Reinforced concrete is cheaper than metal.

I leave here exposed that it was just a pre-sizing to get a sense of values, but to get exact values you need a detailed sizing. That is not the case with this research.

Finally, the research achieved the desired conclusion, because the intention was to analyze two structures made of reinforced concrete and one in metal structure, respecting the NBR 6118 that deals with concrete and the NBR 8800 that talks about steel and reach a finalization. To determine which one is most feasible, but at the end of

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all research shows that the most useful is that I was able to meet the requirements of the project.

REFERENCES

[1] ABNT, BRAZILIAN ASSOCIATION OF TECHNICAL STANDARDS. NBR 6118: Design of concrete structures - Procedure. Rio de Janeiro, 2014.
[2] ABNT, BRAZILIAN ASSOCIATION OF TECHNICAL STANDARDS. NBR 8800: Design of steel structures and mixed structures of steel and difficile concrete. Rio de Janeiro, 2008.
[3] ABNT, BRAZILIAN ASSOCIATION OF TECHNICAL STANDARDS. NBR 6028: summary: elaboration. Rio de Janeiro, 2003.
[4] ABNT, BRAZILIAN ASSOCIATION OF TECHNICAL STANDARDS. NBR 10520: citations: elaboration. Rio de Janeiro, 2002.
[5] BOTELHO, Manoel. Reinforced Concrete I Love You.Sao Paulo: Blucher, 2015.
[6] DEMO, Peter. Methodology of Scientific Knowledge. São Paulo: Atlas, 2000.
[7] DIAS, Luís. Steel structures Concepts, Techniques and Language. São Paulo: Zigurate Editora, 2009.
[8] FUSCO, Pericles. Structural Concrete Technology. São Paulo: Pini, 2012.
[9] GOLDMAN, Pedrinho. Introduction to Cost Planning and Control in Brazilian Civil Construction.Rio de Janeiro: PINI, 2005.
[10] NOVELLI, Rafael. Comparative Analysis: Costs Metal Structure x Structure of Reinforced Concrete.São Paulo:
[11] <https://www.noveseng Engenharia.com.br/analise-comparativa-custos-estrutura-metalica-x-structure-de-concreto/>, 2019
[12] PFEIL, Walter; PFEIL, Michèle. Steel Structure: Practical Sizing.Rio de Janeiro: LTC, 2009.
[13] SILVA, Valdir; PANNONI, Fabio. Steel Structures For Buildings.Sao Paulo: Blucher, 2010.