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Comparative Technical-Economic Study of a Reinforced Concrete Building and a Building With Prestressed Prefabricated Elements. Samborondón - Ecuador

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ABSTRACT

This work is aimed at recognizing the system that has more advantages and technical, environmental, and financial efficiency between buildings using a reinforced concrete structure and this same building with prestressed prefabricated components; from establishing the design of a building that has reinforced concrete and that same building has prestressed prefabricated components, create a technical comparison study of a reinforced concrete construction together with a structure of prestressed prefabricated components, create a financial comparison study of a building that is made of reinforced concrete together with network structure of prestressed prefabricated components, carry out a comparison study according to the environmental scope of a reinforced concrete construction that has a structure of prestressed prefabricated components. In conclusion, it is observed that according to the technical part, it has the advantage of the reinforced concrete system over the conventional one that provides mental comfort to the promoters in some cases. As far as prestressed concrete is concerned, there are advantages as such time-which results from the simultaneity of the activities and ease of selecting more lights between the supports and the lower valuTheages are the handling and implicit risks, transportation and lifting of these components, which can be avoided with proper planning, a certain reliable schedulechnician responsible for the project which is hawhiccanfacturing parts of these elements, minimizing errors. The conclusions above only represent this comparison accorconclusions above cited. Not always does the assembly and manufacture that is in prestressed concrete lower cost, so it depends on the project.

Keywords: Technical not always-economic study, Building, Reinforced concrete, Prestressed prefabricated elements

INTRODUCTION

Regarding construction values and those related to the environment and the Regardre the main objectives of concern according to the development of buildings are based on their profitability and viability. According to the above, in this study, it has been proposed to develop a comparison study to be able to recognize which is the mechanism that has more benefits and technical, environmental, and financial effectiveness between a building, using a

structure that is made of reinforced concrete and in that same building that has prefabricated prestressed components. The intended study is based on the comparative technical, environmental, and financial analysis based on the two construction systems. While both can be used from a strength perspective, the relative benefits of each kind of structure are not known for sure. According to this aspect, the following questions can be determined: Which model represents the most economic advantage? Which of these two models means greater efficiency? What are the benefits and disadvantages of the environmental field? The following research question; What are the technical, financial, and ecological benefits of creating a building, defined by comparing a building with a reinforced concrete structure and that with prestressed prefabricated components?

This research is based on the comparative economic, technical, and environmental analysis of the basis of two means of construction: a reinforced concrete structure building and that same building with prefabricated prestressed components. Several options for construction are proposed according to the building and the type of structure to use. Although they can be used from the perspective of resistance and strength, for sure, the advantages are unknown according to a comparison of each kind of structure between a reinforced concrete frame and prestressed prefabricated components, taking as a purpose of the study to recognize the system that has more benefits and technical effectiveness, environmental and financial. According to the construction, ecological relationship, and ecosystem, the cost components form relevant purposes that cause concern in developing structures marked by feasibility and financial profitability.

According to the indicated, in this project it has been proposed to create a study in a comparative way recognizing which is the mechanism with more benefits and with the technical, financial and environmental efficiency in a building using a reinforced concrete structure and the same building with prestressed prefabricated components; having the general objective of recognizing the system that has more advantages and technical, environmental and financial efficiency between buildings using a reinforced concrete structure and this same building with prestressed prefabricated components; From establishing the design of a building that has reinforced concrete and in that same building has prestressed prefabricated components, create a technical comparison study of a reinforced concrete construction together with a structure of prestressed prefabricated components, create a financial comparison study of a building that is made of reinforced concrete together with a system of prestressed prefabricated components and carry out a comparison study of Agreement with the environmental scope of a reinforced concrete building that has a structure of prestressed prefabricated components.

Concepts of Structures

Overall, building is the order and arrangement of the components of a whole. In engineering, the structure is focused on supporting its weight and the presence of external elements, such as moments, forces, etc., without losing the operating parameters for which it has been conceived (Malazdrewicz et al.,

2023). Such principles are closely associated with the manner and disposition in which Riaño (2017) expresses himself. If you consider how the mechanism affects the structure and how the firm also affects, the system is when you realize why the proper selection of the material is a determining component within the area of the facilities since the stability of work is optimized by a successful piece of the parts to be used and the system that has given more advantage to them (Tene González et al., 2023). The entire structure has to be appropriately integrated and expressed in the form; the indicated record indicates it as the structure itself (Vascones Portilla, 2018). The structural form and construction mechanisms have been significantly altered in recent decades. The frames have been more exposed and irregular, and long prefabricated elements have replaced the methods of masonry walls and concrete floors with more flexible particularities (López, 2016).

Structural Elements

Knowing the systems of the structural classes is relevant to choosing the most appropriate structure since, through this knowledge, the behavior of each system and their proper use in specific circumstances is indicated (Giannetti, 2018). It points out the importance of knowing the area; in the following points, the basic concepts of the most important structural components are specified, which can be classified into: Beams, Columns, Foundations, and Mezzanine slabs (Giannetti, 2018).

Traditional Construction

It is indicated as a conventional construction system to specific constructions of which they use materials that are frequently used, as visualized in Figure 2, and that have usually been preserved for a long time, the structures whose components are blocks, brick, wood, adobe, cane are which have predominated to the Ecuadorian constructions the same that according to the constructive techniques used in the buildings are still operating or constitute a part of the heritage of all facilities (Martínez-Muñoz et al., 2023).

Traditional Construction – Reinforced Concrete

According to Yepes (2020), conventional construction in reinforced concrete has the following benefits: Construction: monolithic methods according to the foundation, beams, slabs, and columns, which enables structural stability. Durability: reinforced concrete is more resistant with more viability to external agents, so its usefulness is more than 100 years. Economy: prices will be able to be reduced if it is designed with the base of bearing walls. Finishes: it makes it possible to make moldings to the plasters of the interior and exterior. Thermal characteristics: it makes it possible to isolate the outside temperature according to the material of your masonry; it will have fire resistance according to the external temperatures. Seismic safety: you have to comply with seismic security.

Disadvantages in Traditional Construction With Reinforced Concrete

Similarly, conventional reinforced concrete construction for Vascones (2018) has some disadvantages. Due to the low resistance of constant bending in the structural components, concrete has to contain reinforcing steels to withstand such reinforcements increasing their construction value (Medina Sandoval et al., 2022). Focused on the confection, concrete needs formwork, so apart from increasing its value, it damages the ecosystem, given that the vast majority of the candy is created based on wood (Villao-Vera, 2022). Furthermore, permanent quality control is needed for the realization of personnel costs. If remodeling is necessary, its materials are not reused, creating construction waste with its appropriate eviction value and its incidence of contamination. Environmental pollution is designed for construction to produce cement, CO2 is emitted to the ecosystem, dust is created when casting, and noise is made inside the buildings (Álvarez Deulofeu et al., 2022).

Construction Systems - Classification

The industry's environment has transformed the structure into the mechanism of any construction system. The design is the required base on which the discovery, installations, furniture, and finishes are developed. The building can be enclosed or only endured (Díaz-Merino et al., 2022). It is for this reason that the structural system is the one that determines the scheme to build, which gives rise to the classification of the different constructive systems that are classified as bidirectional, unidirectional, and tridirectional (Madrid et al., 2022). Along with this, it is understood that they can be flat (plates), volumetric (boxes), and linear (skeletons) (Tanner, 2021). The selection of the system to be used is made considering the type of building, the kind of financing, and the user's requirements (Luna et al., 2022). The different construction systems cannot be classified in order of worst and best, given that they affect their properties and the situation in which they will be used (Mack-Vergara, 2022).

For the box component, being able to reach the work, the only work which remains to anchor it on the ground or another box. However, the parcel may be a limited design component (Chen Austin, 2022). The dimensions indicated by the carrier and the little variations that can be obtained with a few combinations in the plant of the boxes are the considerations that are taken into account. Within this system, the facilities and finishes will be in the factory with the aim of including production from start to finish. According to the design and unique selection, the skeleton system allows more freedom than the previous one. The drawback is generated in which the difference in the boxes, in the assembly, is not in the factory, but in the work where most work and with the conventional construction mechanisms.

The cash machine is the selection of industrialized nations, given the advantages it makes possible in terms of price reduction, according to a correct resolution in residential areas with low-rise housing. Skeletons are used in higher constructions requiring more flexibility (Yepes Piqueras, 2020). According to the same line of construction methods, the system of plates and panels, which are similar and with their fundamental difference, make up

the scale. Panel systems are used in the construction of buildings that do not have much height, while, on the other hand, the plate systems, the elements can be as dimensioned as in a specific space that the construction requires (Cladera Bohigas et al., 2022). As shown in Figure 5, the panel system has formed a significant boom in residential areas with due growth and limited access given that the construction periods are short, do not require much conventional labor, and the mobilization of materials is little.

Prefabricated Construction Systems

Prefabrication is before industrialization; the first prefabricated construction component is perhaps the brick, created outside the work with the medium that has extended over time, more or less to these days (Duque Yaguache et al., 2022). There have been attempts at prefabrication in every epoch of history; the blocks with stone which had been structured for the Egyptian pyramids arrived finished from different places and then be mentioned according to a program that is prefixed, in the position in which Greece is today, the stone blocks of the columns were also prepared external to the work and then were assembled (Huapalla García & Fonseca Alvarado, 2020).

Suppose a procedure or component denotes the particularity of creating in the factory or on-site and leans towards production in the factory. In that case, it can be modified in prefabricated components. Hence, the alternative of prefabrication has to take full advantage of the guidelines that minimize the work to be done on the site (Taccone et al., 2022). Over time, prefabrication systems have been modified to adapt to the requirements and demands of each of the moments (Catur Muraña, 2021). Its beginnings with the usefulness of the prefabricated means of large panels, created in Europe at the beginning of the 50s to be able to solve the inconvenience of housing caused by mass destruction in the period of war (Rojas Julian & Pérez Rojas, 2020). This trend was leaning towards increasingly practical components (exceptionally light), giving a beginning to the development of semi-heavy and suitable prefabricated methods in which the entry of industrialized elements of medium dimension stands out, together with the facilities that this entails about assembly and transfer (Giannetti, 2018).

The capital needed for developing an industry of these particularities is less than for factories that require heavy mechanisms, and production is done more than in the large panel industry (Pérez Oyarzún et al., 2021). In general terms, it is not based on systems with proportional freedom of design; despite this, specific systems with such an approach are already visible. In the process of improvement, elements are created that will be carried out in workshops with high flexibility of realization without having dimensioned limitations of dimension and with reasonable prices. The most relevant advantage of these new methods is that there are suppliers of essential industrialized parts, which will then be processed in the workshops according to the low installation price in which the different elements needed by the system are assembled and then accommodated in work (Bello Zambrano & Villacreses Viteri, 2021). This system has been imposed gradually to exploit the maximum probabilities in component prefabrication.

Regarding prefabricated structural elements, they are made before use and in a different place from their final location. Therefore, it is essential to understand that designing a prefabricated structure is not limited to devising and cutting it into pieces to manufacture. Regarding prefabricated structural elements, they can be classified according to the level of prefabrication, shape, dimension, level of typification, and mechanisms of realization (Huapalla García and Fonseca Alvarado, 2020).

Prefabricated Construction Systems

Reinforced concrete is indicated as the most popular and developed according to the construction materials since it effectively takes advantage of the properties of adequate resistance to durability, understanding, fire resistance, and moldability of concrete, according to those of the strength in the ductility of steel and tension to create a composite material that groups several advantages of the two materials that are components (Vascones Portilla, 2018). The prestressed will be developed in two ways; the prestressed reinforcements in which the tensioned tendons are poured.

MATERIALS AND METHODS

This study has been created according to descriptive research; when referring to the methodological framework, it is required to expose the term paradigm, that, which has as meaning to make references to a scheme as a way of thinking or to the guidelines for a study, which can lead to the development of the theory, This means that it is the initial phase of any research or a degree project, as well as the present one; to conceptualize it better is mentioned that a paradigm is the grouping of attitudes or beliefs as a perspective of the world (Ballina, 2021). These paradigms of the present study have been able to identify two, which are qualitative and quantitative. To know the most critical components, in the present study, the research approach is of mixed type since it uses two conceptions, qualitative and quantitative research. In addition, descriptive analysis was considered since the study aims to collect data and information to be evaluated and studied objectively (Hernández, 2016). To determine the comparative indicating which is the system with more advantages and technical, environmental, and financial effectiveness, the following stages of study are determined.

Technical comparison stage of guidelines and materials; on the revision of the construction procedure for prestressed prefabricated components and the review of the usefulness of the prestressed mechanism to improve the designs of structural elements. Stage of comparison of values and time; on the systematic review of the quantities and analysis of the unit values of the construction items in Reinforced Concrete, the systematic review of the amounts and the study of the unit prices of the construction items in Prestressed Concrete, the review of the comparison and the formation of the corresponding budgets, the definition and review of the times through a valued schedule carried out in MS Project focused on the structure of the Reinforced Concrete, the report and review in the times through a respected program carried out in MS Project focused on the structure of the Prestressed

Concrete and the comparative study of the prices of the different systems and the periods of realization.

RESULTS

About the comparison study that has been identified which is the mechanism that has more advantages and technical, financial, and environmental efficiency among all buildings using a structure in reinforced concrete and in that same building with prefabricated prestressed components, the results of this study are evidenced below Technical comparison of parameters and materials. As evidenced in the table, the differences between the two systems regarding materials and technical parameters indicate great relevance when selecting one. Indeed, the use of precast concrete elements in any engineering work requires that you be diligent about the construction details of the joints of these elements. Therefore, some points that need to be considered are described below.

The Union of the column – Foundation: This proposed system needs a foundation that is melted in place along with the incorporation of cancellers, which allow the reception of the prefabricated columns; the candlesticks have to have a clearance of 3 to 5 cm on each side, which allows the entry of the section of the column and then filled with grout.

Union of the beam–column: For this approach, it is required the application of more metal brackets that are supported in the queues for the Union of the rays, whether loaders or moorings. To consider the negative moment of this Union, the steel or the necessary reinforcement will be placed on site. To view the posijoyousent in this Union, on the other hand, the prefabricated beams will have a lower perforation so that the rods are located in work, and the overlap is generated together with the reinforcement of the loading beam, to be then sealed and injected into the work with grout.

Union of the loading beam – double beam: It is necessary that the loading beams are those that have the section partially prefabricated and that they have the capacity so they can support the weight of the beams that are double in the assembly and also the weight of the overload created by the topping casting and the balance of the section. It is proposed that the double beams Te, are incorporated into the berayshat are either the perimeter or central loaders. To obtain that, the nerves of the double Te beams must be emotional in the body of the loader beams.

This is partially obtained by prefabricating the beams that are loaders, as shown in Figures 7 and 8, to complete the action on-site once the prefabricated floor components and longitudinal reinforcing steels of the beams above have been installed. Use of prestressing technique (prestressing) to optimize structural element designs. It has been inclined to consider that the foundation will be melted in place, adding candlesticks that allow the reception of the prefabricated columns. For the rest, the central loader beams, the perimeter loader beams, and the double T beams will be prefabricated by the economy; it is suggested to implement the pre-forced method to opt for an improved cost-effective model. It should be noted that the concrete of all precast prestressed components to supply will be more significant than 450 kg

/ cm2. The prefabricated columns To reduce construction times, personnel, and materials, it is proposed to use the prefabricated columns, together with the section of 65x65 cm with a length of 30.30 meters.

CONCLUSION

To improve the models of the loaders, it is inclined to propose a design of the inverted T, that is, the section that is partially prefabricated either for the central loaders or the perimeter ones. These beams will have the steels for shears salted, with a rough surface to receive the second concrete phase. The raised beam is designed for the maximum joyous moment in the center of the shaft with the prestress and reinforcement steels. On the other hand, the reinforcing steels must be supplied and located by the customer on-site for the negative moment and in the torsion. The capacity of the component-loader beam has been analyzed, showing that a better degree is achieved to withstand bending forces. To carry out the following analysis, it is necessary to review plans and technical specifications for this development to reach the quantities and values that go according to what is required. Determination of quamountsith analysis of unit prices of reinforced concrete construction items.

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