ABSTRACT
Reinforced concrete was the material of choice for many architects of the modern era, exploiting the material in a multitude of creative and innovative ways. Many of the most extraordinary structures of the modern era demonstrate the potential of reinforced concrete and illustrate the rapid evolution of the material throughout the 20th century. It is the most used material in the construction industry due to its high resistance and its ease of molding when it is prepared, it also contains steel in the form of rod and wire, with a useful life of its components, built as a system, for more of one hundred years as long as they are well designed, well built and above all they are given adequate maintenance. However, the durability of concrete structures depends on several main environmental factors, the quality of the raw material and its maintenance. Some of the studies and research projects on the subject of Concrete focus on the historiography of reinforced concrete in Colombia, where some authors highlight aspects of construction processes, technical innovations, construction companies, and architecture and engineering projects that were pioneers in the 20th century. In Colombia, a historical context of this material and the most representative projects in the city of Bogotá, Colombia are detailed below.

Keywords: preventive conservation, concrete buildings, modern heritage, reinforced concrete, Bogotá, Colombia.
1 REINFORCED CONCRETE IN COLOMBIA

In the 19th century, some countries such as England, France, Italy, Germany and the United States devoted a large part of their efforts to the advancement of new materials that allow improving the construction processes of their works. One of these cases is the elaboration of natural cements that were developed through the firing of clays and limestone rock. Although the use of cement dates back to the Roman Empire, its rediscovery is attributed to John Smeaton (1724-1792) when in the mid-18th century, he needed to develop a waterproof material for the construction of the Eddystone lighthouse. These experiences in making cements with lime and pozzolans lead to the creation of Portland-type cement by Joseph Aspdin, who patented it in 1824 (Addis & Bussell, 2003, p. 22). The use of this material spreads throughout the world, arriving in France in 1856, the United States in 1865 and Japan 10 years later (Vargas Caicedo, 2006, p. 15). This expansion makes the use of this type of material multiply throughout the world and its use becomes common when seeing the resistance and durability it offers.

In the current Colombian territory, the use of materials such as the tread wall and the use of stone in constructions throughout the colonial period and the 19th century was privileged for a long time. However, from very ancient times some type of mixture with lime was used as a mortar for gluing stone masonry or ceramic elements. This is the case of some of the works in Santa María la Antigua del Darién, founded in 1510, lime and sand mortars were used to improve the works and constructions (Vargas Caicedo, 2006, p. 14). To this is added that, in some much more recent civil works such as the new Santa Fe aqueduct of 1775, mixtures with lime were used, since this is a good binder for the glue mixture used to join bricks and atanores.

The nineteenth century had had notable difficulties in raising capital and building various types of infrastructure works. The recovery after the Wars of Independence, civil wars and difficulties in obtaining financial resources made things difficult in the construction of public works. However, at the end of the 19th century, the volume of foreign currency inflows from abroad for the concept of coffee exports, allowed large sectors of society to benefit from this better economic situation, which generated that new possibilities of expansion could be contemplated and development (Arango Cardinal, 1989, p. 129).

In the nineteenth century and the beginning of the twentieth century, the bloodiest civil war that the country had experienced until then occurred. The Thousand Day War catastrophically affects the country, impoverishing it and damaging a good part of exports and infrastructure, as well as leaving at least 200 thousand dead on the country's fields, which is a significant figure for a country that it has about 4 million inhabitants at this time. The war leaves another result and it is the separation of Panama. This situation of hopelessness and frustration opens the way to a new stage in which it is necessary to organize a state with institutions that allow development and progress throughout the national territory.

The arrival of refugees from civil wars and people looking for better opportunities to live in the
urban centers intensify the problems of the city in terms of housing and public works in general, both aspects were still to be developed. Even so, advances such as the new means of transport, the train, the tram and the new factories made the city an attractive place for the settlement of new inhabitants.

Bogotá, during the turn of the century, observed a rapid densification of the city. At the beginning of the 19th century, it had a population close to 20,000 inhabitants, and by 1912 it shows a substantial increase, reaching 116,000 (Mejía Pavony, 2000, p. 229). This generated great problems, because, although the city had multiplied by five its population, the area had not expanded in the same way and it continued conserving the colonial limits. To cope with this growing population, many of the colonial dwellings were subdivided to accommodate the new inhabitants (Arango Cardinal, 1989, p. 140) in conditions that soon led to overcrowding.

The continuous wars and the arrival of new inhabitants have responses from the public and from the private. As for the public, after the Thousand Day War, Rafael Reyes (1905-1909) began his presidential term. The government known as the Quinquenio de Reyes achieves profound transformations in the management of the state; he sees that the construction of new civil works for the cities is a mechanism to reach the material progress of the whole society. In institutional matters, it establishes a policy for the construction of civil and engineering works, for which it creates the Ministry of Public Works in 1905. The mission of this entity is to establish a policy for the construction of buildings that would allow the development and connection between regions. (Arango Cardinal, 1989, p. 129).

From the private initiative, steps had already been taken to build industries at the national level to overcome the serious problems facing the country. One of the most outstanding, arises in the 19th century from the hand of the engineer Miguel Triana, who since 1887 begins to develop a type of cement, which is even endorsed by national chemists such as Francisco Montoya and Luis Herrera (Escovar & Cárdenas Angarita, 2006, p. 48).

Despite these attempts, the use of imported materials such as Portland cement from England or some brought from France was still favored. This is mainly due to costs, the production capacities of these countries and their quality. However, a fortuitous event would change this situation. In 1891, the Carrizosa Brothers: Camilo and Antonio, they tried to build an electric power plant based on the use of coal. This plant did not give the expected result, in large part due to the difficulties in obtaining quality coal. But, for 1892 Santiago Samper Brush proposed to build an electric power plant based on hydraulic power.

The plant was finally built near the Salto del Tequendama. Among the difficulties they encountered, one of the ones that stood out the most was the importation of construction materials such as cement, which had very high costs and was expensive to transport from the ports to Bogotá. This situation, and the advantages of developing an industry during the first decade of the 20th century, thanks to the constructive impulse of new works advanced by the government allowed that, by 1909, the Cementos
Samper Factory will be inaugurated (Escovar, Mariño & Peña, 2004, p. 440).

However, the cement industry would not be the only one that would develop in these times. To this is added the production of bricks in small workshops in the southeastern sector of the city, the smithies and ornamentation workshops also begin to increase in quantity at this time (Saldarriaga Roa and Fonseca Martínez, 1989, p. 182).

The use of cement had already been carried out in the country, although it was generally done in not very large jobs and for very specific things, this due to the difficulty of importation and costs. The Samper Brush Brothers found a great way to advertise this new material they were offering. In 1910, the Independence Centennial Festival was presented in Bogotá. For this occasion and in order to publicize the use of cement, they give the city a construction called the Kiosk of Light, being the first construction that makes use of national cement for its preparation (Escovar, Mariño & Peña, 2004, p. 440).

The new industry brought Colombian engineers this product that could be used for the construction of aqueducts, sewers and other civil works. Among them, it is worth highlighting the works of the Chapinero aqueduct carried out by Manuel José Peña and endorsed by the Person Engineering House (Vargas Caicedo, 2006, pp. 18-19). As time passes, the way of construction changes and it is already beginning to be noticed that by the beginning of the decade of the 20s, floor plates are preferred, no longer in stone, but rather the use of tiles is promoted. new concrete slabs.

The arrival of the 1920s constitutes a period of change and great dynamism for the country. On the one hand, coffee is consolidated as one of the country’s flagship products, becoming the great contributor of foreign currency to the national economy, and its expansion allows money to reach important production sectors (Niño Murcia & Reina Mendoza, 2014, p. 33). Another factor that substantially increases the economic resources of the country is the compensation of Panama. These capitals allow urban facilities to be built throughout the country, among the most outstanding works are the railways and state institutions.

One of the missions was to take advantage of the large resources that came from abroad. The government had hired the Kremmer mission, which suggested that it institute a central bank that would allow it to have financial stability, which will be done in 1923. This type of measure would allow the government to request loans abroad to advance the public works to be carried out. will need. (Niño Murcia & Reina Mendoza, 2014). The arrival of economic resources allows a revitalization of the country, and the construction of infrastructure works such as new government buildings, railways and roads.

The 1920s look for a new way to develop and plan the growth of the city. Among them comes the Bogotá Futuro plan, the first plan to establish an urban perimeter. In it, the construction of a geometric city with a grid that goes from the San Cristóbal River to Calle 112 is proposed, with wide roads, monuments and equipment for the city (Niño Murcia, 2016). These plans would not be developed, but
they begin to raise the question of how the city should grow and what limits should be set in terms of its expansion.

The growth in terms of the size of the city and the arrival of more people every day open a new front of needs in the city. On a general level, the idea of development and of seeking modernity based on civil works and equipment, has in cement a great means to achieve this. The construction of aqueducts, slaughterhouses, paving, among other infrastructure works, make use of cement on a regular basis. Some particular cases in the use of this material can be contemplated in the construction of foundations, the aqueduct works, as well as floors for the municipal slaughterhouse, the Mercado Central, Chapinero and Las Cruces squares and some schools, built by the Ulen House (Escovar & Cárdenas Angarita, 2006, p. 126). Similarly, the 1920s saw a construction boom. The Central Technical Institute — ITC, for example, was training its students in reinforced concrete construction techniques under the tutelage of the Lasallian brother and Belgian architect Geric Benjamin, who participated in the construction of the ITC headquarters on 13th Street. The plans published in the ITC magazine of this decade demonstrate the strong interest that construction systems in reinforced concrete had received (Mayor Mora, Quiñones, Barrera & Trejos, 2014, pp. 364-374).

In this period, republican architecture, incipient in previous decades, was consolidated (Arango Cardinal, 1989, p. 165), but was progressively being replaced, since new proposals are emerging that are close to the modern styles of more developed countries such as those of Western Europe or the United States, and a model of urbanism and modernity is beginning to be seen in them. The use of new materials and architectural typologies similar to those built in the aforementioned countries can be seen in the buildings of commercial companies and banking institutions, which wanted to show the air of modernity that they brought. To carry out these new works, foreign architects and technicians were mainly hired.

Among them, the building contracted by Pedro A López stands out, and built in steel covered in cement by the North American architect Robert Farrington in 1923 (Colombian Institute of Culture. Colcultura, 1996, p. 103), the Mortgage Bank, built by the North American architects Paul Stuper and Fred T. Ley, and the Banco de Colombia built between 1920 - 1924 by GB Webb and WM Partridge.

These foreign professionals are joined by some nationals who are in charge of doing works with new construction techniques, where cement becomes a fundamental material. One of these cases is that of the architect Arturo Tapia and the engineer Ernesto González Concha, in the construction in 1924 of the Faenza Theater. In the same way, the engineer architect Alberto Manrique Martín (1890-1968), making use of railway rails, developed an eight-story concrete-jacketed structure for the Cubillos Building, completed in 1926. (Escovar & Cárdenas Angarita, 2006, p. 49) and the Banco de Colombia built between 1920 - 1924 by GB Webb and WM Partridge.
THE 30S. THE FIRST MODERNITY

The decade of the 30s, an important construction impulse continues, but certain changes are generated at the political level, of institutional reorganization both in the national territory, as in Bogotá and the arrival of new members and ideas for the development of both the city and the country.

The conservative party that had ruled for more than 46 years is replaced by the liberal party. The liberal party, from the government, promotes new programs for the material development of the country. Among them the intensification of industrialization under the pressure of the Second World War, which leads to the need to substitute imports. This makes possible the creation of new industries, and that the industries that already existed have a period of expansion. A clear example is the cement industry.

In 1909, production began at the national level with the Samper Brush Brothers factory, in the 1930s and 1940s it expanded its production. The number of factories in the country is increasing, an example of this is the Cementos Argos factory in Medellín, the Cementos Diamante factory in Apulo, Cundinamarca, and the plants in Bucaramanga and Valle del Cauca (Vega, Fernández, Giraldo & García, 1977, pp. 57-60).

During and after World War II, the need to replace steel and cement imports arose at the national level. SIMESA began to produce steel in the country in 1938, since the Siderúrgica Nacional de Paz de Río, fundamental in the production of steel for the reinforcement of concrete structures, was created by National Law 45 of 1947, aimed at the "investigation from the coal fields, Regarding concrete, given the absence of national standards, the Colombian Society of Engineers requests the Materials Testing Laboratory of the National University to carry out tests of the materials produced in the country in order to establish their resistance coefficients and make the calculations. based on these (Galindo Díaz, 2019, pp. 45-46).

The cements of national production will have special characteristics with respect to the imported ones, which would lead the engineers of the Materials Testing Laboratory of the National University to propose a change in the formula with which the concrete resistance was calculated after 28 days of setting (Slater formula), since Colombian cements under local conditions achieved greater resistance in less time,

The new government reorganized the Ministry of Public Works, especially its dependency on National Buildings in 1932. Which, along with other actions such as the creation of official entities, the creation of the Central Mortgage Bank, and in Bogotá of the Social Action Institute, They allow opening new possibilities for construction both in the capital city and in other territories of the country (Saldarriaga Roa and Fonseca Martínez, 1989, p. 194).

In the 1930s, the city was already thinking about the need to build and direct a new urban policy for its imminent growth. The contributions of the Austrian architect and urban planner Karl Brunner, designer of Avenida Caracas (Zambrano Pantoja, 2007, p. 40) and head of the office of the Department
of Urbanism of the city stand out, advancing in it, a neighborhood improvement policy, road improvement, development of public space and equipment for neighborhoods. The establishment of new entities and new competencies for them is compounded by the arrival of new Colombian professionals, trained in architecture and engineering at foreign universities.

They are joined by architects educated at the National University, who embrace a modern sense of constructing architectural works and buildings under the aesthetic and functional parameters of the Modern Movement. An example of this is the architect Alberto Wills Ferro, who had advanced studies at the National University, and later specializes at Columbia University in the United States. Wills Ferro designed, for example, the National Library building, built between 1933 and 1938 (Niño Murcia, 2003, pp. 134-135), a building in which sloping roofs are still implemented and the symmetry in plan and facade is maintained, but which is a clear example of the new paradigms of rationalist architectural design, which breaks with the classical tradition.

Two events brought a great impact to the city, in the 30s. The first, the agreement 12 of 1935 known as the works plan for the fourth centenary of the founding of the city, in which the sanitation of some neighborhoods would be established, as is the case of Paseo Bolívar, the construction of sewerage and paving works, among others. All these advances sought to give the city hygiene, an air of modernity and space for cars. The second is the construction of the campus of the National University of Colombia, for which a piece of land was chosen on the outskirts of Hacienda el Salitre. The challenge of building the university city was raised by the first presidency of Alfonso López Pumarejo (1934-1938), who entrusted the architect Leopoldo Rother with the work.

Figure. 01. National Library (Alberto Wills Ferro, 1933-1938). Photo: Sady González, 1950.
3 1936-1950. A PERIOD OF TRANSFORMATION AND TRANSITION

Despite the continuous economic recessions that took place in the global context of the war, as of 1934, with the arrival of the government of Alfonso López Pumarejo (1934-1938), the country began to show signs of moving towards a political, economic modernization, and even social. This reformist spirit ranged from a constitutional reform, through a tax reform, which substantially increased the national budget, an agrarian reform, even an organic reform that transformed the National University of Colombia. Similarly, in this spirit of reforms and changes, entities are built that promote the construction and development of the country.

Among them the Agrarian Fund and the Colombian Savings Bank, It is for the sake of improving economic conditions and public investment in different sectors of the national economy. In the same sense, in 1939 the Territorial Credit Institute was created, with the idea of building houses for low-income people both in the countryside and in the cities. In the municipal branch, in 1942 the Popular Housing Fund was established, assuming functions that the Social Action Institute had, promoting the construction of housing in the popular sectors (Saldarriaga Roa and Fonseca Martínez, 1989, p. 196).

The city of Bogotá continues to show rapid growth for these years. The city went from 100,000 inhabitants at the beginning of the 20th century, to just over 330,000 inhabitants in 1938. A significant population growth that leads to the need to enable new work and housing areas. In 1938 the Ministry of Labor was created and in 1939 the Children's Hospital was founded in Bogotá, which would later be named after its founder, the nation's first lady Lorencita Villegas (Torres del Río, 2010, p. 149).

With the increase of inhabitants in Bogotá, the need arises for more urban infrastructure works. For 1944, the Soto-Bateman Plan appeared, proposed by the mayor Jorge Soto and the secretary of works, the engineer Alfredo Bateman, who proposed reorganizing the city by zones according to their activity, as well as the expansion of some roads to decongest the center, one of them Carrera Décima, which is proposed as the road of the future and the solution to decongest a large part of the traffic in this central area of the city (Niño Murcia & Reina Mendoza, 2014, p. 45).

The national and municipal administrative organization sees the need for housing for broad sectors of society and for plans to improve the mobility situation in the capital. In the 1930s and 1940s, with the arrival of foreign and national architects, the formal change in the city began to take shape through developments in architecture, engineering and urban planning. During the López Pumarejo government period, some architects came to build the National University, as is the case of the German Leopoldo Rother (Goossens, 2014, p. 211). During the government of Enrique Santos Montejo (1938-1942), some technicians, architects and engineers, trained in European academies, mainly Jews, requested to enter the country fleeing from the difficult political situation generated by the Spanish Civil War and by the persecution that preceded the Second World War, as exemplified by the life of Otto Helmuth Mármoek.

While in the case of Colombian architects there is the aforementioned Alberto Wills Ferro and the Nel Rodríguez Haeusler from Antioquia, among others. They apply to enter the country fleeing from the difficult political situation generated by the Spanish Civil War and by the persecution that preceded the Second World War, as exemplified by the life of Otto Helmuth Mármoek (1917-1945), he, an architect of Jewish origin, or that of Manuel de Vengoechea (1911-1983) of French origin (Carrasco Zaldúa, 2004, p. 160).

While in the case of Colombian architects there is the aforementioned Alberto Wills Ferro and the Nel Rodríguez Haeusler from Antioquia, among others. They apply to enter the country fleeing from the difficult political situation generated by the Spanish Civil War and by the persecution that preceded the Second World War, as exemplified by the life of Otto Helmuth Mármoek (1917-1945), he, an architect of Jewish origin, or that of Manuel de Vengoechea (1911-1983) of French origin (Carrasco Zaldúa, 2004, p. 160). While in the case of Colombian architects there is the aforementioned Alberto Wills Ferro and the Nel Rodríguez Haeusler from Antioquia, among others.

Figure. 02. Banco de Colombia Building (Martínez Cárdenas y Cía., 1949-1953-59).
The arrival of new architects, construction technicians and engineers, significantly invigorates the practice of construction in the country. Consequently, two events occur. First in 1934, the Colombian Architects Society was founded, with the idea of organizing the construction union and establishing direct communication between the members, for the development of their profession in the country. Second, in 1936 the Faculty of Architecture of the National University of Colombia was created, which allows the academic training of architects, which was previously done abroad (Saldarriaga Roa and Fonseca Martínez, 1989, p. 195).

The construction of the university materialized between 1938 and 1941. Among the many buildings designed by Rother for the university are the National Chemical Institute and the Printing House. In 1941 and 1945, respectively, the use and management of concrete techniques on a large scale began to show itself in the use of this material on sight. For example, in the printing press, design by Rother (Saldarriaga Roa and Fonseca Martínez, 1989, p. 197).

For example, the implementation of concepts such as volumetric simplicity, the open plan (on concrete pillars, reducing load-bearing walls), and the flat walkable roof, as well as the optimization of the construction process through standardization, modulation and the prefabricated ones, respectively, the use and handling of large-scale concrete techniques are beginning to show in the use of this material on sight. For example, in the printing press, design by Rother (Saldarriaga Roa and Fonseca Martínez, 1989, p. 197).

The technical knowledge brought by these experts not only influences the construction of the National University buildings, but also the training of new professionals, who in turn will progressively change the face of the city, largely thanks to concrete. For example, the implementation of concepts such as volumetric simplicity, the open plan (on concrete pillars, reducing load-bearing walls), and the flat walkable roof, as well as the optimization of the construction process through standardization, modulation and the prefabricated ones. The use and handling of large-scale concrete techniques are beginning to show in the use of this material on sight. For example, in the printing press, design by Rother (Saldarriaga Roa and Fonseca Martínez, 1989, p. 197). The 1940s represent a period of great dynamism for architecture in Colombian cities. Progress at the material level and new educational, economic and political opportunities open the door for an important development in society, both in architecture, engineering and even in the creation of new companies (Saldarriaga Roa and Fonseca Martínez, 1989, pp. 195-196). Figures such as Jorge Gaitán Cortés appear in the architecture, who will play a significant role in the development of the construction of Bogotá. Roberto Pachón, a highly active engineer and concrete silo builder on the outskirts of Bogotá, who later participates in construction activities such as the La Salle Institute.
To the appearance of new architects, there is also the creation of associations between architects and engineers who create the first architecture, design and construction firms. This is the case of the Trujillo, Gómez y Martínez Cárdenas firm, which developed an intense activity from 1933 to 1949 in the construction of buildings such as the Cárdenas Building of 1937, the Gómez Dávila Building of 1937, the Banco de los Andes built in two stages, the first in 1939 and the second in 1949; and the Insurance Company in 1945 (Carrasco Zaldúa, 2004, p. 154). the first in 1939 and the second in 1949; and the Insurance Company in 1945 (Carrasco Zaldúa, 2004, p. 154).

The new ideas brought by architects and engineers have a material ally that is concrete, a material, still incipient in the 1940s, but which is beginning to be adopted not only in facilities but also in rationalist and zoned housing architecture. One of these cases is the Mazuera house, built in Fusagasugá, the work of the architect Vicente Nasi (Arango Cardinal, 1989, p. 216). Its design is adapted to local construction technologies thanks to the efforts of the architects Álvaro Ortega and Gabriel Solano. An example of this would be the change in mentality in which the wooden frame windows are being replaced by metal frames, and the old ceilings built with wooden trusses and a clay tile roof are being displaced by other flat concrete construction systems.

As early as the 1930s, concrete is beginning to be seen as promising for new builders. In 1936, the Compañía Constructora de Obras de Cemento was created, in a union between Cementos Portland Diamante and Compañía de Cemento Samper. This company would be dissolved in 1941, but the same members would form a new company in 1942 called Compañía Concretos Triturados Limitada, dedicated to the production and commercialization of concretes and aggregates. Finally, the participation of the cement company Portland Diamante would be sold to the engineering firm Pardo Restrepo y Santamaría, becoming a new company called Central de Mezclas Ltda.; this company in 1954 would be associated with the firm Cuéllar Serrano Gómez, in the construction and development of the Siderurgica de Paz del Río complex (Escovar & Cárdenas Angarita, 2006, p. Four. Five). Which shows the continuous growth of the cement industry in the country from the 1930s onwards.

4 1945 - 1970. A NEW AIR, A NEW MODERNITY

In the 40s and 50s a significant change is experienced in the world. European countries lost much of their power in World War II (1939–1945) and now two new powers are installed on the cusp of world domination. On the one hand, the United States is installed as the new dominant power of the capitalist world, and on the other side; the Soviet Union, remains in control of large areas in Europe and Asia, establishing itself as the great bastion of communism. Colombia, due to its proximity, and its traditional alliance with the United States, makes them its economic allies and a benchmark for its development.
The country continues with its long problems of violence, mainly in rural areas, even though it will have a large urban episode such as El Bogotazo. The fratricidal war between the two traditional parties, liberal and conservative, lives for years in which violence is exacerbated, which ends up characterizing that period as the time of La Violencia. This situation notably increases the growth of the city, which receives immigrants from the countryside. The growth can be seen in the number of inhabitants that are registered.

The city has grown from 335,000 inhabitants in 1938, to 715,000 in 1951, and in 1964 it has expanded to 1,697,000 inhabitants (del Castillo, 2008, p. 9). Similarly, the urban extension goes from a developable area of 2,500 hectares in 1938, to more than 8,000 in 1958.

The city is seen as a safe center for the development of new inhabitants, many of them who have come from rural areas in the search to change their situation of extreme poverty and to escape persecution for political reasons. Juan Carlos del Castillo establishes that modernity is seen from various angles. For some wealthy elites, modernity is understood as the problem of not adapting the advanced ideas that exist in other parts of the world. In other words, ignore the development of the world and not apply it to our country (del Castillo, 2008, p. 6).

For this group, the city offers a space and potential to develop new ideas and ways of building. Other sectors of the population, without abandoning the desire for material progress, they will understand this problem as a loss of Christian ideology and civilized traditions. This sector would see Franco's Spain as a great reference.

And finally, a last sector of the population would have their hope in the modern city, understanding by this the overcoming of the conditions of misery and state abandonment that they would have suffered in other areas of the country, and that made them come to the capital in search of opportunities and forms of association that supported their wishes for improvement, such as unions. (Torres del Río, 2010, pp. 123-126) understanding for this the overcoming of the conditions of misery and state abandonment that they would have suffered in other areas of the country, and that made them come to the capital in search of opportunities and forms of association that would support their wishes for improvement, as were the unions. (Torres del Río, 2010, pp. 123-126) understanding for this the overcoming of the conditions of misery and state abandonment that they would have suffered in other areas of the country, and that made them come to the capital in search of opportunities and forms of association that would support their wishes for improvement, as were the unions. (Torres del Río, 2010, pp. 123-126)

In terms of financing, a new capital bonanza arrives in the country. Among them, new loans from international organizations, increases in the production and sale of coffee, generate a favorable investment environment for new projects, such as the National Public Works Plan of 1947, and a restructuring promoted by the Lauchlin Currie plan. in 1950. The massive arrival of money and the accumulation of
private capital, mainly in large cities, accelerates the development process from a completely rural country at the beginning of the century, to a mainly urban society since the middle of the 20th century (Niño Murcia & Reina Mendoza, 2014, pp. 38-39).

An event that would substantially change the country occurs on April 9, 1948, with the assassination of Jorge Eliecer Gaitán and the popular uprising that occurred because of this event. A significant number of buildings, both public and private, were severely damaged or destroyed during the skirmish. April 9 opens the door to the promotion of new plans to reorganize the city and expand the scope of urban renewal of the historic center.

Both the national and municipal administrations had already tried to make some urban reorganization plans, but after this fact, with the impulse of the mayor of Bogotá Fernando Mazuera Villegas, the Bogotá Plan Office was created (Agreement 88 of the Council) with the aim of applying scientific urbanism to the development of the city. From abroad, the doctrine of the International Congresses of Architecture — CIAM, creators of the Athens Charter of 1933, speaks of the need to plan cities in favor of community life and the health of their inhabitants, improving their relationship with architecture through nature (especially sunlight and green areas). Among the recommendations made, a series of parameters that a city should have in order to be considered modern were established.

Among them was the delimitation of urban areas, classifying them between housing, commerce, industry and other uses; implementation of public services, limiting the growth of cities through urban plans, establishing a hierarchy for roads, as well as advocating for the use of new materials and construction methods, some of the most representative CIAM references in the world are the architects and urban planners Charles Edouard Jeanneret-Gris, known as Le Corbusier, the German Paul Wiener and the Spanish architect and urban planner Josep Lluis Sert. In 1947, Le Corbusier was hired to modernize the city. A year later, Paul Wiener and Josep Lluis Sert would join, who will complement the ideas of Le Corbusier.

The instruments used for the development of the city were divided into two: a Pilot Plan, approved during the mayoralty of the architect Santiago Trujillo Gómez (Municipal Decree 185 of 195), also called the Master Plan, and the Civic Center Plan for the historic center and city government. Between the two plans, they defined the distribution and division of the city into 42 districts, the establishment of a road categorization, the construction of the Civic and Administrative Center, the regulation of zoning and the opening of new housing sites, the extension of urban public services and the establishment of new public spaces in the city (Tarchópulos, 2013, p. 270). Some of the plans proposed by the architects and urban planners were carried out, but due to the criticism they received for the excessive destruction of the colonial center that they implied, as the architect Carlos Martínez referred to, they were only partially and limited accepted (Arango Cardinal, 1989, p. 215).
The growth possibilities granted by the regulatory plans and the annexation of the new municipalities in 1954 to the urban structure increased the construction fronts throughout the city.

In the 1940s and 1950s, new construction, architecture and design companies were created. Among them, the company to which Germán Samper joined in 1946 stands out, the firm Esguerra Sáenz Urdaneta Ltda. With whom he designed and built important buildings such as the Central Mortgage Bank, the Muzú neighborhood, the Gold Museum, and the Luis Ángel Arango Library, among others (Arango Cardinal, 1989, p. 233).

Another of the outstanding architecture firms that emerged in the 1940s is Obregón Valenzuela y Cía., Initially made up of Pablo de Valenzuela, José María Obregón Rocha and Rafael Obregón González, they built important buildings such as the Bavaria complex, in which the commercial offices on the first floors are combined with high-rise housing.

Other architectural firms in which concrete will play a fundamental role will appear around 40, such as Ortega Solano and Gonzáles Zuleta in 1945; Herrera and Nieto Cano in 1948; and Martínez Cárdenas y Cía. in 1949. Due to the volume of work, they developed, the firm Cuéllar Serrano Gómez stands out. Integrated by the architect Camilo Cuéllar Tamayo, Gabriel Serrano Camargo and the engineer José Gómez Pinzón. They would build important works of architecture such as the Ecopetrol Building, winner of the National Architecture Award in the first Colombian Architecture Biennial, the Seguros Bolívar building on Carrera Décima, the San Carlos Hospital, and the expansion of the San Juan de Dios Hospital, among many others (Serrano Camargo and Martínez Jiménez, 1983, pp. 55-88).

For some engineers, their works are not limited only to their name, but to their temporary association with several of the great architecture and design firms. One of them is Domenico Parma, who arrived in the country from Italy in 1946 working as a plan reviewing engineer for the municipality and later joining the firm Cuéllar Serrano Gómez. Where he helped in the design of the Banco Central Hipotecario, located in the Santander Park and the Gold Museum (De Roux Giovanelli & Arteaga Botero, 2018, p. 9). Another of these engineers is Guillermos González Zuleta, who worked with several of the most recognized architects in Colombia, including Lepoldo Rother,
For his part, the architect Gabriel Serrano also contributes to the national progress of concrete engineering. Observing the projects being built in Brazil, when he traveled there in 1947, he developed a new structural system for lightened mezzanine slabs, in which the upper plate is supported by a framework of joists that distributes the forces in both directions equally. With the help of the engineers Domenico Parma, José Gómez Pinzón and Andrius Malko, they named this cellular reticular system (Serrano Camargo and Martínez Jiménez, 1983, p. 91; Vargas Caicedo, 2009, p. 68), which was implemented for example in the, currently demolished, El Dorado Airport.

5 CONCRETE DEVELOPMENTS FOR ARCHITECTURAL STANDARDIZATION

The Instituto de Crédito Territorial created in 1949 the Workshop for Research and Application of Materials — TIAM, a laboratory for special bricks and precast concrete elements for mezzanines and facades such as beams, staves and modular frames, which were considered ideal to achieve more constructive processes, economic and of good duration, in such a way that a greater coverage of the demand for housing was achieved and a low deterioration during the amortization periods.

With these principles, neighborhoods in Bogotá such as Los Alcázares and Niza are developed, in which with the joint participation of several architectural firms, wood is substituted with precast concrete in the design (Roa Rojas 2014, 231-237). This effort, aimed at the middle classes of the city, is combined with another effort of a social nature. Giving continuity to initiatives of the Social Action Institute, then the Popular Housing Fund, and the Central Mortgage Bank, and driven by the Currie mission and the
OAS, the Inter-American Housing and Planning Center — CINVA, also led by the ICT, was created. The headquarters of this research center for planning and interdisciplinary urbanism is built at the National University, in which, through the Community Action methodology, low-income people are educated in housing construction techniques with modern technologies (Peña Rodríguez, 2008).

The CINVA investigations in relation to cement, left a wide literature on the blocks of compressed earth stabilized with cement, known as "soil-cement bricks", and the manual machine for the production of these blocks, which was developed by CINVA and patented in 1958 in Colombia. This technique was conceived for rural use and successfully implemented in various regions of the country (Vargas Rubiano & Vargas Caicedo, 2007).

The economic cooperation plan of the United States, called Alliance for Progress, approved in 1961, allowed the entry into Colombia of 12 million dollars “for the construction of houses and apartment buildings” (Torres del Río, 2010, p. 284). Which, added to other financial aid, made it possible to search for new housing solutions. Two projects stand out for the use of concrete during the 50s and 60s. The first is the Muzú neighborhood unit (1955), built by the Instituto de Crédito Territorial, in which in its original design single-family houses are established in a row connected by a large public space with pedestrian paths and communal facilities, within the logic of the super block, but without tall buildings (Goossens, 2014, p. 219). And finally the Antonio Nariño Urban Center,

Another construction system that is characteristic of the 50s is the light brick or concrete vault, the brick “plank” or Catalan ones, have a more or less clear genealogy, since they were taken from ancestral traditions by Le Corbusier in a couple of emblematic projects of these years: the Sarabhai house in Ahmedabad, India, and the Jaoul house in Paris.

Colombian architects who worked in Le Corbusier’s workshop, such as Rogelio Salmona, later implemented them in Colombia in the 1980s (García, Magdalena & Medina, 2018). On the other hand, the Colombian-Catalan engineer Alfredo Murtra Casanovas contributed to the development of this roof system in projects such as the houses of the architects Francisco Pizano de Brigard (demolished), Guillermo Bermúdez (Escovar & Cárdenas Angarita, 2006, p. 89) and Jorge Gaitán Cortés, the latter built with the “armed ceramic” system, made with hat bricks, created and manufactured by this architect (Galindo Díaz, 2019, pp. 115-118).

On the other hand, the laminar concrete vaults would be developed initially by Álvaro Ortega (Rodríguez, 2008), who carried out research on vacuum concrete (Vacuum Concrete, patented in the USA, 1948); constructive process that he had learned at Harvard during his student days with Walter Gropius (Medina, García & Rodríguez, 2019, p. 49). With this method, a minimum thickness vault was achieved by injecting concrete under vacuum, through a pump, in a reinforced form, This reduced the amount of water required to set and made the element more resistant to damage caused by rain, since the pressure of
the construction process eliminates the need for subsequent waterproofing. The assembly and casting were
done on the ground and later lifted with a crane to its place on the deck. This technique would be used in
Bogotá, for example in the Clark Gum factory (1953) (Medina, García & Rodríguez, 2019, pp. 49-52) and
in the Muzú and Quiroga neighborhoods (Escovar & Cárdenas Angarita, 2006, p. 91).

The international model that Skidmore Owings & Merrill-SOM embodied in the 50s in the Lever
House tower in New York, and the building of the Ministry of Education and Health in Rio de Janeiro,
designed by Lucio Costa and Oscar Niemeyer, in which the They take up the ideas of Mies van der Rohe
and Le Corbusier on developing projects in height based on modules and prefabricated elements, which
allowed to streamline construction and achieve a modern aesthetic while generating densification without
sacrificing pedestrian space, they will serve as references for the architects in Colombia. Who will exploit
the expressive potential of concrete, but not the anonymity of glass.

For example, the Tower-Platform typology was perfected, with which an access floor with wide
pedestrian circulation can be combined, some floors for commercial use that make up a base with a terrace,
and on top of these one or more slender vertical blocks for home or office use (Fontana & Mayorga, 2008,
p. 100). The success of this model can be verified in a large number of modern buildings in Colombia.
Early examples such as the Carrera Decima buildings are found in Bogotá, especially the Banco de Bogotá
(1959) built by Martínez Cárdenas y Cía. and Pablo Lanzetta based on SOM designs; and the Bolívar
Insurance Building (1959) by Cuellar Serrano Gómez y Cía.

There are also examples of this typology that achieve a notable use of exposed concrete, such as
the Banco de Comercio building built between 1957 and 1958, the Bavaria architectural complex, winner
of the 1966 National Architecture Prize, and the Grupo Gran Colombiano building (1965) on Seventh
with Calle 12C, all three designed and built by the firm Obregón Valenzuela y Cía.

Finally, one of the buildings that would have the greatest impact on the city would be the capital's
first modern skyscraper: Torre Avianca, designed by the firms Esguerra Sáenz and Samper Ltda., And
Ricaurte Carrizosa and Prieto Ltda., The structural plans would be designed by engineer Domenico Parma,
who introduced the arcaded reinforced concrete superstructure for this building, based on North American
regulations. The building began to be built in 1965 and was completed in 1969, significantly changing the
surroundings of Santander Park (Villate, 2019). One of the buildings that would have the greatest impact
on the city would be the capital's first modern skyscraper: the Avianca Tower, designed by the firms
Esguerra Sáenz and Samper Ltda., and Ricaurte Carrizosa and Prieto Ltda., the structural plans would be
designed by the engineer Domenico Parma, who introduced the arcaded concrete superstructure for this
building, based on North American regulations.

The building began to be built in 1965 and was completed in 1969, significantly changing the
surroundings of Santander Park (Villate, 2019). One of the buildings that would have the greatest impact
on the city would be the capital's first modern skyscraper: the Avianca Tower, designed by the firms Eguerra Sáenz and Samper Ltda., and Ricaurte Carrizosa and Prieto Ltda., the structural plans would be designed by the engineer Domenico Parma, who introduced the arched concrete superstructure for this building, based on North American regulations. The building began to be built in 1965 and was completed in 1969, significantly changing the surroundings of Santander Park (Villate, 2019), who introduced for this building the arched superstructure in reinforced concrete, based on the North American regulations.

The building began to be built in 1965 and was completed in 1969, significantly changing the surroundings of Santander Park (Villate, 2019). who introduced for this building the arched superstructure in reinforced concrete, based on the North American regulations. The building began to be built in 1965 and was completed in 1969, significantly changing the surroundings of Santander Park (Villate, 2019).

Another highly attractive technical exploration was the laminar structure. One of the first structures of this type in Bogotá was designed in 1950 by the engineers Antonio María Gómez and Raúl Zambrano, built by Pardo Restrepo & Santamaría for the Abadi Hermanos textile factory, implementing cement from the Central de Mezclas Ltda (Galindo Díaz, 2019, p. 46). Leopoldo Rother’s work for the National University campus also stands out as a precursor in the implementation of concrete membranes. In 1937 he designed the Alfonso López Stadium whose stands are covered by a cantilever structure that supports a concrete membrane with a reduced section. In 1945 he designed the headquarters of the printing press, today the Museum of Architecture, with laminar vaults that protrude from the facade forming eaves.

One of the brightest minds in engineering in Colombia was Guillermo González Zuleta who, from his position in the Office of National Buildings, would work with Rother on two emblematic projects at the national level: the Girardot Market Square (1946-1948) and the Cartagena Stadium (1947). Both projects have been extensively studied. In Bogotá, in 1950 González Zuleta made the structural calculations for the Bogotá Bus Station (demolished), designed by the architects Álvaro Ortega and Gabriel Solano. The design created large free surfaces for the maneuvering of the buses, which were covered by cylindrical membranes of minimum thickness. The building was reviewed by the American magazine Architectural Forum in 1954 as one of the worldwide examples of the use of the shell concrete system.

Another structural project that draws attention is the one that González Zuleta developed in 1955 for the covered stands of the paddock of the Hipódromo de Techo, in which he implements a constructive system for cylindrical membranes known as “armed ceramics”, which consists of a brick grid (that fulfill the function of caissons) separated a few centimeters from each other, where the reinforcing rods are arranged to later melt the layer of concrete on top (Galindo Díaz, 2019, pp. 72-85).

The next step for this lightened laminar system with ceramic elements would be the paraboloid section membranes, which allow the maximum height of the vault to be greater than half the length of the
covered span, which is not possible with vaults. cylindrical. One of the projects built in this typology is the Chapel of the Holy Apostles in the Modern Gymnasium of Bogotá, originally designed by Juvenal Moya Cadena in 1953 with its four light bays, however, he continues to work on the structural calculation with González Zuleta, it was decided that the vaults would be conical, giving greater opening to the external section.

Other examples in Bogotá of the good reception that the Moya Cadena churches had, designed with elliptical section membranes in “armed ceramic”, are the temple of San Cristóbal (1954) and the temple of the University of La Salle (1962) (Galindo Díaz, 2019, pp. 110-117). When working on the structural calculation with González Zuleta, it was decided that the vaults would be conical, giving greater openness to the external section.

Other examples in Bogotá of the good reception that the Moya Cadena churches had, designed with elliptical section membranes in “armed ceramic”, are the temple of San Cristóbal (1954) and the temple of the University of La Salle (1962) (Galindo Díaz, 2019, pp. 110-117). When working on the structural calculation with González Zuleta, it was decided that the vaults would be conical, giving greater openness to the external section.

Other examples in Bogotá of the good reception that the Moya Cadena churches had, designed with elliptical section membranes in “armed ceramic”, are the temple of San Cristóbal (1954) and the temple of the University of La Salle (1962) (Galindo Díaz, 2019, pp. 110-117). When working on the structural calculation with González Zuleta, it was decided that the vaults would be conical, giving greater openness to the external section.

As seen, the dominance of reinforced concrete has been demonstrated since the 1950s in Colombia, not only as the reception of a fashion but as the evolution of the country's economy, which at first must respond to the shortage of imports during and after World War II; and in a second instance it is benefited by the substantial financial support from the northern hemisphere during the Cold War.

A part of the architects who assumed the European ideas of modern architecture, stripped it of its socio-political origin, making possible formal and spatial explorations in high quality reinforced concrete, while on the other hand very convenient standardization and prefabrication systems were developed. for housing solutions.

We see in Bogotá exponents of the expertise of Colombian architects and engineers in architectural gestures such as large lights, cantilevers, porticoed super-structures, and load-bearing facades. In works such as the Super Rayo Market (Pizano Pradilla Caro Restrepo, 1955) the SENA (Germán Samper, 1958) the Pan American Life Insurance (Germán Samper, 1967), the laminar structures of Juvenal Moya, the El Salitre Sports Unit (Camacho and Guerrero, 1971), the El Campín Coliseum (structural design by Gillermo González Zuleta, 1973) and the International Trade Center (Cuéllar Serrano Gómez y Cía., 1977), among many others.
REFERENCES


Architecture Magazine (2), 82-95.


Bogotá: Pontificia Universidad Javeriana.


