Guanajuato, Plaza de la Paz.

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Analysis and proposal of sustainable urban mobility: accessibility to the cultural heritage of the City of Guanajuato; Gto

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ABSTRACT

Through this research and analysis, its intention is to restructure the corporate public transport road network of the Patrimonial city of Guanajuato, based on a systemic approach created by transfer centers and avoiding vehicular traffic. To make the historical center an available, safe, and fast space, with less environmental impact and friendly, we pretend to change the structure of the city. Mobility is a necessity in cities, but it is also a right; it occupies a central role in society while allowing communication, economic activity, and integrating spaces and events; It is needed for all people to access the essential goods and services of a dignified life. The method of analysis that considered is Urban Sustainability as a set of systems, which explains that anyone who presents a problem produces an imbalance in the rest. Therefore, the Urban Sustainability Index (ISU) should understand as a degree achieved by the city to maintain the balance of all systems present in urban life. The elements used were: historical analysis, photographic records, public transport routes, diagrams of vehicle flows, and previous drafts. Its scope changes road capacity and accessibility, quality of life, sustainability, economic, social viability, equity, and quality of the environment. This project is aimed at improving and developing the infrastructure with a set of economically profitable actions. It proposes that short and medium-term actions contribute to a long-term vision and strategy.

KEYWORDS

sustainable urban mobility, cultural heritage, and accessibility

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1. INTRODUCTION

Historically, Guanajuato is a city in which among its main urban issues. It has had to attend to how its mobility carried out since the introduction of motorized vehicles in the early nineteenth century. There was road congestion because of its irregular urban fabric and its limited circulation alternatives. With the vaulting of Padre Belauzarán street in 1951, the bottleneck that existed on Sangre de Cristo street dissolved; because a new road alternative generated and thus operating each street for opposite directions. It is from here that the idea to embovedar the Guanajuato river and form the Miguel Hidalgo highway starts. By 1960, Guanajuato's capital had 49,794 inhabitants in the urban area. The urban fabric stretched from the dam to the railway station, having only three urban truck routes: Estación-Presa, Cantador-Pastita, five de Mayo-Cata. (Mendoza, Carrillo, Castellanos, 2015).

A strategy was carried out based on the proposal to increase roads despite the few possibilities, already back then, to do so. Thus, it gave guidelines to generate more road alternatives through the river dome, also as Guanajuato would forge the main characteristic that gives it an identity. Governor Torres Landa was the one who included in his "Plan Guanajuato" project to create an underground street since it would solve not only sanitation and road problems but also enhance the aesthetic value of the City. The embankment of the Guanajuato River began to become a street, opening in 1964; The project included ramps that go down from Mercado Hidalgo, Los Angeles and the Jardín de la Unión. This new road was called Miguel Hidalgo. (Mendoza, Carrillo, Castellanos, 2015). With these urban modifications,

Figure 1.
Urban landscape of the city of Guanajuato.
Streets and alleys
(photographs: public domain November 2019).

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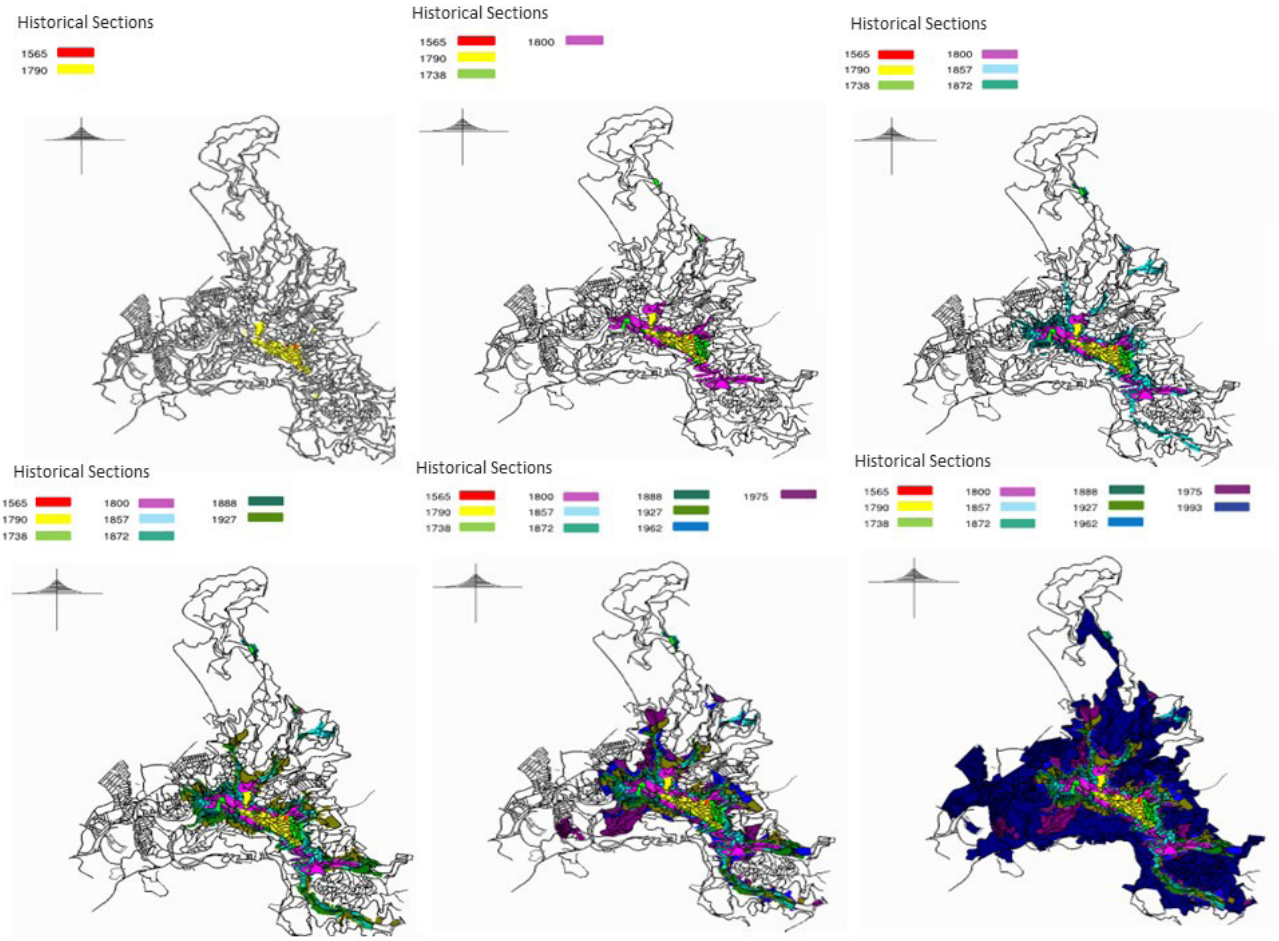

Figure 2.
Elaboration based on the historical stratification of the city of Guanajuato from 1565-1993. Capital cities, an urban historical vision. Volume 3 (source: Cartography INEGI 2004., Photographs: Public domain July 2019).

it would open the way to the development of more buildings, both residential and commercial, resulting in the expansion and growth of the urban fabric on a new level, however, even without adequate territorial organization.
It is essential to mention that the motorized vehicle was an innovation that, at the time, provided a solution to the commercial and freight transport sector, so since then, priority has been given to the fact that the main roads fulfill the requirements of vehicular mobility before pedestrians. The City of Guanajuato has an irregular layout in terms of the composition of its vehicular and pedestrian streets; this has a strong influence. In terms of the structure of its urban design, furniture, low implementation of green spaces, few considerations for the mobility of people with disabilities. The truth is that each era defined its structure of roads and elements according to its majority users.
Regarding the transportation system of the City of Guanajuato, it is currently made up of shared systems between 7 collective urban and suburban bus companies. One of these with sprinters (fish tanks), four taxi lines, the Uber service, and some called "executive taxis,"; as well as the routes established following the physical, road, and traffic conditions of the municipality, the different companies that provide the transport service. The collective public transport structure of the City of Guanajuato made up of various sites that function as bus stops and journey terminals, as well as the assigned routes that serve as links between.

Figure 3.
Stage 8. Evolution of the city of Guanajuato. From the end of the 18th century, Guanajuato took the foundations to develop the urban context that we contemplate today
(source: Colmenero F. (2017). Conservation of the Urban Landscape in the Historic Center of the City of Guanajuato (S XVI- S XXI). Architecture and Urbanism, vol. XXXVIII, no. 3, September-December, 2017, pp. 100-106.).

2. GUANAJUATO: CITY OF MINING ORIGIN

Before the arrival of the Spanish and its discovery of the silver deposits, the area that the current City occupies is inhabited by indigenous tribes of Chichimeca origin. The original name of the mentioned place was Paxtitlán which means place of paxtle, (pasture), at present it is the Pastita neighborhood, as a Hispanic deformation of the indigenous word. Initially, the City formed into Haciendas de Beneficio, later in areas, barracks, and blocks. Currently, its conformation is based on the neighborhoods that delimited with each other.
The predominant thing in the City is the residential architecture, which its origins have been simple, with a clear dominance of massif over the span and which is only a patent reflection of the Spanish influence and that of the Arab culture. The public image is not made up of a single system; it is the result of the articulation of several elements, which is why it is considered the mental representation, symbolic construction or value judgment associated with the imaginary of the city inhabitants through the social perception of the landscape (Arcos A., 2012). The lack of accessibility in the physical environment of one, in communication, technology, products, and teaching has caused unsuccessful adaptations in the development of cities, affecting the urban landscape in a 21st-century society where they are assumed to be healthy. Worryingly, those cities are taking a course in their transformation and the sense of identity, belonging, collectivity, and importance of the intangible landscape that Mexican cities are world heritage are losing.

3. OPERATION OF URBAN TRANSPORT

Guanajuato has a territorial surface greater than 30,500 square kilometers; its population is almost six million inhabitants. Besides, it is part of the 12 entities with the highest participation in international trade agreements; suffice it to say that 70% of the state's exports go to the United States. The main productive activities that take place in the state of Guanajuato are

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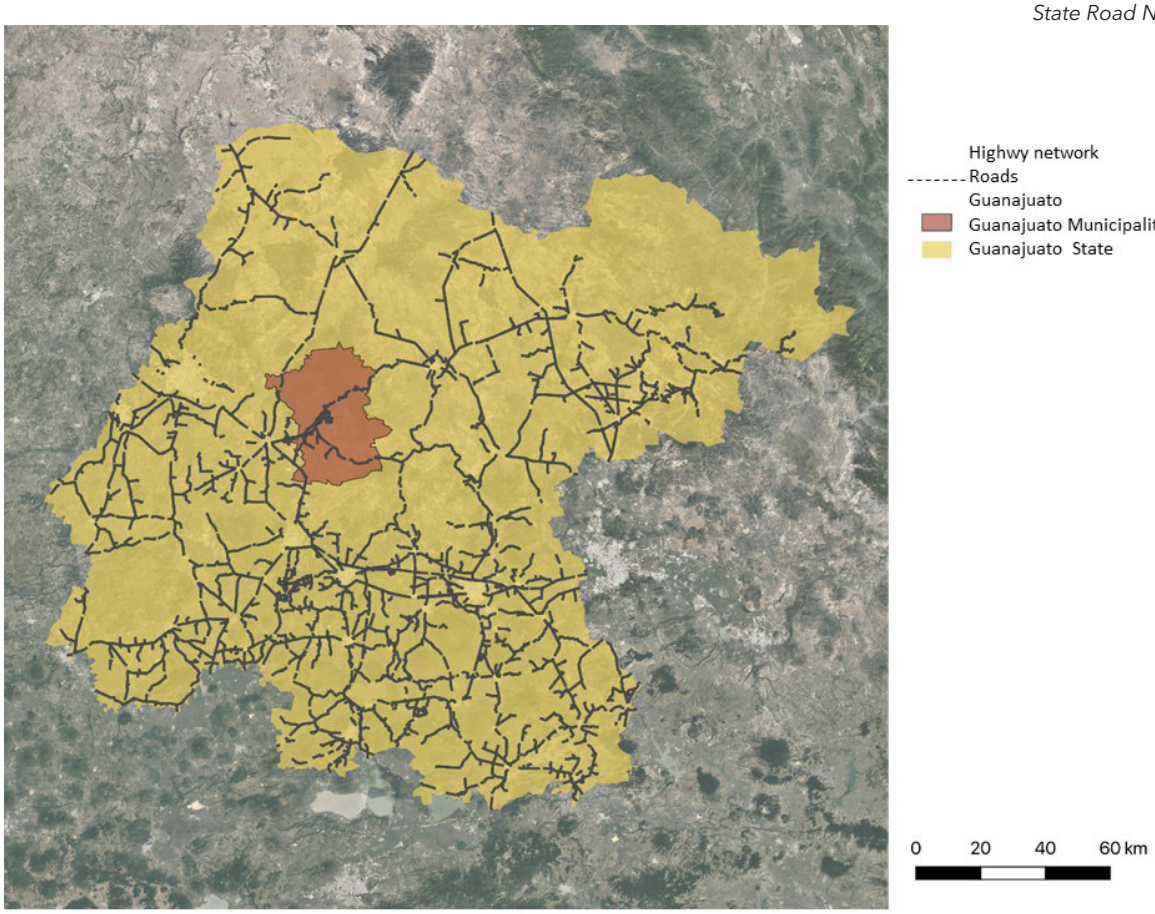
commerce, construction, manufacture of machinery and equipment, the food, and real estate industries. Similarly, sectors such as agribusiness, clothing-textile, automotive, research services, pharmaceuticals, among others, stand out.

This context is an incentive for constant improvement in the maintenance and creation of communication channels that allow mobility and connectivity of people. In recent years, some infrastructure works in Guanajuato have been launched, and concretized, focused on meeting this objective, which is why it is positioned in one of the best-connected states in road infrastructure nationwide.

Regarding the municipality at present, the Miguel Hidalgo highway is a leading road network of the City of Guanajuato, which is reached by various intersections of other systems, so it is possible to divide it into sections, in which each one corresponds to demand different that ranges from 230 vehicles per hour to 1290 in hours and days of maximum demand, which corresponds from 6:45 p.m. to 7:45 p.m. The road is divided into 11 sections, from the capacity study, the degree of saturation (GS) is obtained, where

Figure 4.
Road infrastructure network of the state of Guanajuato and its municipalities (authors elaboration with data from the State Road Network 2016).



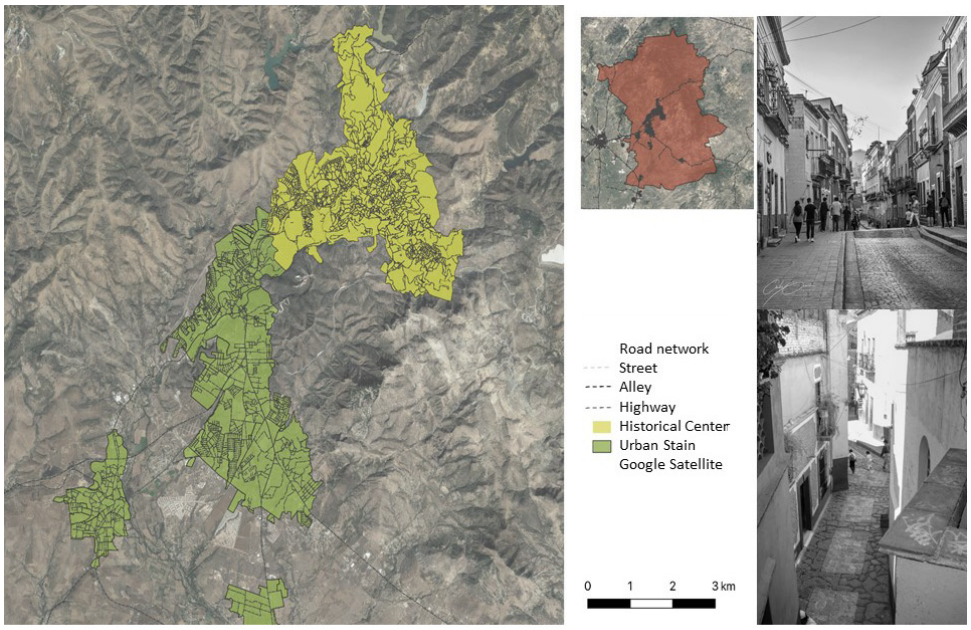


Figure 5.
Road and pedestrian infrastructure of the municipality of Guanajuato (prepared by F. Colmenero Fonseca with data from the State Road Network 2016. IPLANEG. Guanajuato base map. 2019).

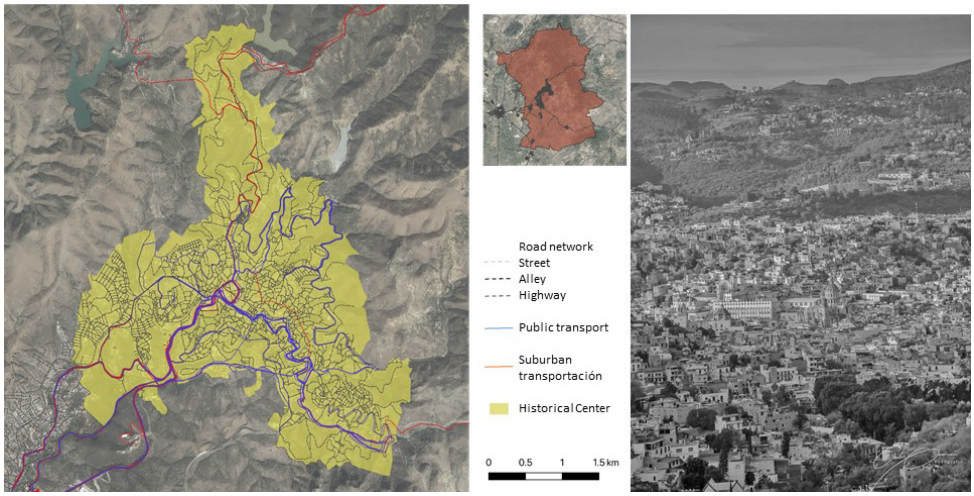


Figure 6.
RUrban and suburban transport system. Arrivals in the historic center of the municipality of Guanajuato (prepared by F. Colmenero Fonseca with data from the State Road Network 2016. IPLANEG. Guanajuato base map).

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it can be seen that three parts are saturated: From the UNESCO roundabout to the Tepetapa Bridge, from El Patrocinio parking to Los Angeles, and Juan Valle to the Alonso ramp. (Mendoza, Carrillo, Castellanos, 2015). The main complication of the urban transport system in the City of Guanajuato is due to the fact that several of the routes converge on the same main highway, Avenida Juárez, being the same route with long, winding and calm paths that go from north to south. from the City. It is worth mentioning that due to topographic and morphological issues of the City, the roads, streets, and alleys that follow the ways of life and the main routes for collective and private-public transport were traced. In the municipality, the most widely used public transport system is the cooperative urban transport system, due to its capacity and diversity of routes that cover a large part of the City of Guanajuato. Currently, there are seven companies that provide transport services of this type: Transportes Urbanos de Guanajuato Ávalos S.A. de CV , Transportes Urbanos y Suburbanos Ávalos S.A. de CV, Autobuses de Guanajuato SA de CV , Autobuses Suburbanos Ávalos S.A. de CV, Transportes Diava de Guanajuato SA de CV, MED-CER, CUGSA.
These companies share different urban and suburban routes with their respective schedules and units already defined. A previous analysis of the roads was established, where it is concluded that the collective public transport system covers a large part of the territory; However, the routes are not very efficient and we could hardly obtain a smooth circulation since most of the activities take place in the historic center and 80% of the Guanajuato population comes from the southern area. As in many other Mexican and Latin American cities, the public transport system has several complications that make it inefficient; Problems that cause citizens to choose to move in a private vehicle and create traffic congestion, another limitation is the few public parking lots.
From the 19th century to date, the excessive growth of the City prevented the creation of alternative routes. For this, mobility strategies are proposed through a master plan created from transfer centers. The objective of urban mobility is, without a doubt, to satisfy the needs and activities of daily life, in order to reduce private transport, since they generate a high economic cost and environmental pollution.
The main factors that intervene in people's mobility are economic income, gender, age, occupation, and educational level (Vasconcelos 2010). According to statistics, regarding gender, men and women move in the City differently, to different places and with other means and modes of transportation.
The differences regarding mobility lie in the different customs according to the socioeconomic groups. In this way, the ways of using space and getting around, as well as the greater or lesser mobility of one and the other, can strengthen or reduce gender inequality. Based on the above, the objectives of the studies are 1. Detail and describe the general situation of collective public transport in the municipality of Guanajuato. 2. Understand the different types of accessibility, being a city with an inclusive society. 3. Generate a proposal for various networks in the collective public transport system appropriate to the situation of the municipality of Guanajuato, as well as the necessary changes that must be made to make accessibility and sustainable mobility possible.

4. CLASSIFICATION OF THE CURRENT COLLECTIVE PUBLIC TRANSPORT SYSTEM

This research covers information from the year 1960 to the present (2017), since it was the period when the start of the current system was generated with three original routes to which others have been added according to the growth of the urban fabric and new travel needs; however, to date, no radical change has been attempted in this system.
As previously mentioned, from its origins, Guanajuato has had the problems of adequate and planned mobility in terms of its infrastructure thanks to its soil conditions and disorganized settlements. It is a heritage city, in development and with a high number of inhabitants. It is necessary to study the phenomenon and understand how these results were being produced, which, currently, cause conflicts

Figure 7.
Comparison of current public transport routes (prepared by Fabiola Colmenero Fonseca). Organization chart of the territory and transport routes (elaborated Cristian Alan Cruz Ramírez. 2019).

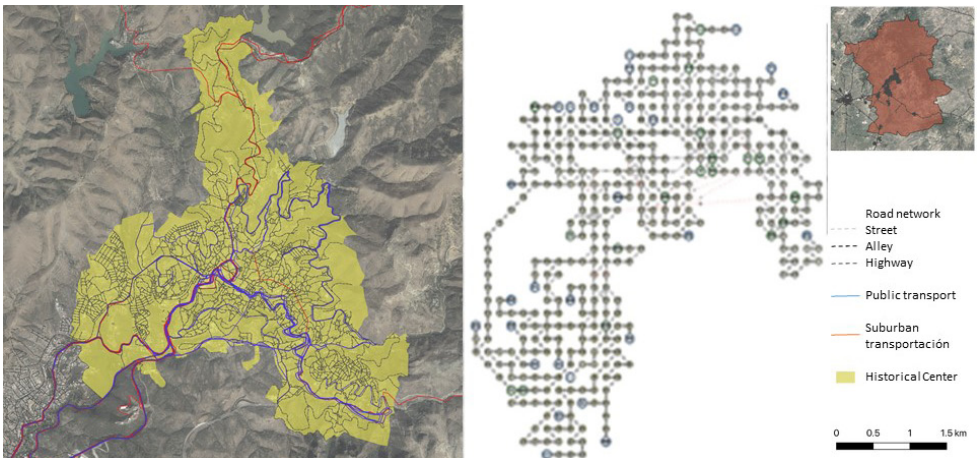
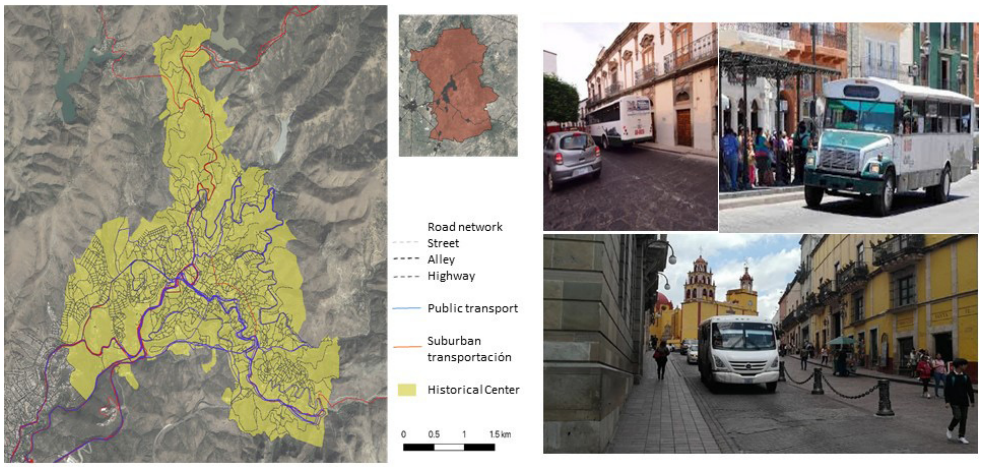


Figure 8.
Guanajuato Urban Transport Routes (prepared by: Fabiola Colmenero Fonseca, with data collected from: geoinfo.iplaneg.net Publication date: Nov. 25, 2014. Photographs: Public domain 2019. Data from the State Road Network 2016. IPLANEG).



and delay progress towards a decent quality of life for their habitants; Thus, we are looking for solutions proposals to get closer to this utopian sustainable urban mobility. In principle, the conflict is in the roads of the downtown area, however, it is necessary to carry out a study on the City's road system in order to provide a comprehensive solution; that is to say, the delimitation of the investigation will be made starting from the downtown area of the City, continuing with the distribution of roads to the periphery. Currently, the transportation system in Guanajuato is dedicated to providing the service in almost all the urban areas; In its organization, factors such as the amount of population in each area, as well as the type of business and the peak hours are considered.
It can be said in general terms that it is a functional system, although it still has factors to improve and consider. There are established and impossible to change roads in the Guanajuato road route, so the different points of the City are connected between these roads. The problem is that the paths are not entirely well established, generating long and saturated routes. The perception that each Guanajuato has regarding his way of seeing the public transport of the City is variable, some have had negative experiences, the frequency with which they use the system, and other factors contribute to their image. Three hundred surveys were carried out on people from the City of Guanajuato, where it was obtained that the system has deficiencies both in the organization and in the conditions of the buses, as well as the treatment they receive from the drivers and their way of drive.

Here are some survey questions:

1. What means of transport do you normally use? (146 people answered)
   Collective public (urban buses / fish tanks) - 101 people (66.18%)
   Private vehicle - 31 people (21.23%)
   Uber or similar - 8 people (5.48%)
   Taxis - 2 people (0.68%)
   School or business transportation - 1 person (0.8%)
   Walking - 2 people (1.37%)
   Other - 1 person (0.68%)

2. How do you rate the collective public transport system in the municipality of Guanajuato? (146 people answered)
   Good - 10 people (6.85%)
   Regular - 45 people (32.88%)
   Poor - 52 people (37.67%)

3. What do you consider to be the main problem with this system? (146 people answered)
   Operators (drivers) - 45 people (30.41%) Vehicles - 39 people (26.35%)
   Routes - 17 people (11.49%)
   Users - 16 people (10.81%)
   All of the above - 4 people (2.7%)
   Others - 27 people, different answers (18.24%)

4. Do you consider that the routes are well planned? (145 replies)
   Yes - 65 people (44.83%)
   No - 75 people (51.72%)

Others - 5 people, different answers (3.45%)

Sustainable development in terms of accessibility and mobility is sought. Based on the background, the following research question arises: What aspects of collective public transport should be modified to achieve sustainable mobility and accessibility in the municipality of Guanajuato? To solve the study problem, the following research questions were asked: What are the current road characteristics and the transportation system in the city of Guanajuato? What issues of reduced mobility appear in the municipality, and what are the universal accessibility considerations or measures that have been taken? What would be the most suitable collective public transport system for sustainable mobility in the municipality of Guanajuato?

5. USE OF ALTERNATIVE MATERIALS TO REDUCE THE ENVIRONMENTAL IMPACT IN CONSTRUCTION

With the increase in population and the proportionally increasing need for housing, urban problems are growing. Among these, we find the search for a final destination for domestic waste, the disposal of wastewater, the generation of waste from civil construction and metal and industrial waste and by-products. Within these latter aspects, the production of debris at all levels, the activities of construction, remodeling, and demolition are sheltered.
The number of construction, remodeling, and demolition work in cities are continually increasing as a consequence of the growth and socio-economic development of the urban population. Much of this waste could be recycled, reused, transformed, incorporated, etc. so that new construction materials could be produced and meet the demand for simpler, more efficient and cheaper alternative construction technologies that mainly satisfy populations: lower income and small and medium entrepreneurs.
Despite this, in many countries, the management of the RCD has as a final solution to the dumping of this waste in large open fields, management that presents little control. It is necessary to find comprehensive solutions that allow proper handling, management and use of the different materials that make up the R.C.D. Civil construction, by its very nature, is the segment with the highest capacity to absorb these new technologies and new materials, produced and developed from the use of waste. These include the cement industry, companies in the pavement industry, urban and rural infrastructure companies, developers and government entities, among others. The non-use of these residues causes environmental problems such as inadequate disposal, the reduction of the useful life of sanitary landfills and final disposal sites for RCD, and negative impacts such as landscaping, contamination of water sources, generation of particulate material, the compaction and change of use of soils, the silting of rainwater harvesting systems, among others.
By giving the RCDs a proper use, they would be directly assigned an added value, so those people who work around these materials would be favored by being articulated throughout the recycling chain. In this way, a culture of collection, management, and adequate dumping of the rubble would be obtained, which would allow the RCDs to represent an additional economic income to that already obtained by transporting it to the authorized sites.
The lack of these tools necessitates the development of studies and actions that focus on the recycling of this type of materials, in order to establish all the technical and scientific support that allows the generation of professional standards and the necessary legislative measures to encourage and endorse the reuse. , recycling, and the use of RCDs. Below is a proposal for the construction of one of the transfer plants from recycled or waste-based materials:

Recycled concrete for construction

The environmental problem posed by Construction and Demolition Waste (commonly called RCDs) derives not only from the increasing volume of its generation but from its treatment, which is still unsatisfactory today in most cases. The insufficient prevention of the production of waste at source joins the scarce recycling of those generated. Among the environmental impacts that this causes, it is worth mentioning the contamination of soils and aquifers by uncontrolled landfills, the deterioration of the landscape, and the elimination of these residues without taking advantage of their recoverable resources.
Recycled concrete waste has been shown to be a viable technical and commercial alternative in the production of recycled aggregates for use in applications that do not have higher requirements for strength and durability []. The recycling of concrete is a necessary task to achieve the effective use of both RCDs and proper environmental management. Currently, the use of recycled aggregates for pavements is mainly restricted to the support layers of roads and highways (bases and sub-bases) []. There is a consensus in the scientific environment that there will be a continuous increase in the number of concrete waste materials, a

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decrease in disposal areas, at the same time that there will be a decrease in non-renewable natural resources for construction. It is why it becomes necessary to investigate the possible use of recycled concrete as an ingredient for the production of new concrete and its effect on the properties of these mixtures. To determine its viability, as well as the impact on the features–resistant and durability of the projected structures.

Alkaline Activation / Construction with Geopolymeric Materials

Alkaline activation is the generic term that is applied to the reaction of a solid aluminosilicate (called a "precursor") under alkaline conditions (induced by an "alkaline activator"), to produce a hardened binder based on a combination of aqueous phases alkali-aluminosilicate and/or alkaline-earth/aluminosilicate.

Geopolymer concrete can be manufactured by adopting the conventional techniques used in the manufacture of Portland cement concrete. The main difference between geopolymers and Portland cement concrete is the binder. Generally speaking, in geopolymers, the geopolymeric paste that binds coarse aggregates, fine aggregates, and other unreacted materials to form geopolymeric concrete is made almost entirely of industrial waste such as thermoelectric fly ash and different types of industrial by-products, which is a great environmental advantage when compared to the production of Portland cement concrete.

Alkali activated binders can be used in a wide variety of ways, both in precast and on-site concrete. There is an industrial-scale deployment of alkaline activation technology in some parts of the world, for example in Australia, where this technology emerged, it has been used for on-site concreting work, such as the 40,000 m3 of slip-form pavement used in Brisbane West Wellcamp Airport in 2013-4 (T. Glasby, 2015), as well as the use in numerous road infrastructure projects by the state agency VicRoads (F. Andrews-Phaedonos, 2014) (JSJ van Deventer 2012) and other end users (JSJ van Deventer, 2015). The application and standardization of these materials in Russia and Ukraine has been based on both prefabricated and on-site work (C. Shi, 2006) (PV Krivenko, 1994) (JL Provis, others 2014) as well as the deployment of 'Pyrament' in North America in the 1980s and 1990s (TB Husbands, PG Malone, 1994) (C. Ozyildirim, 1994) and recent larger-scale applications in South Africa (C. Attwell, 2014) (B. Wilkins, 2013), the Netherlands (A. Buchwald, 2012) and the United Kingdom (A. McIntosh, 2015) (PC Hewlett, 2014) Related materials and systems, using alternative forms of chemical activation (as opposed to strictly alkaline) and fly ash from High in calcium, they have also been commercially deployed in the US (R. Patel, 2012) (D. Cross, 2005).

Established concreting protocols and skillsets are mostly applicable for the handling and placement, or pouring of alkali-activated binder-based concretes; The workability of these materials in the current state may be more complicated than that of modern Portland cement concrete due in part to the current lack of availability of highly effective rheology control agents. Still, it has been proven in the field that a workforce Experienced in concreting can effectively use alkali-activated materials.

The scope of application of alkali-activated binders is broad and continues to grow, with proven use in: reinforced concrete, smooth concrete, precast concrete components (including light elements), both enhanced and unreinforced, and including pipes, mortars, grouts and plasters, foamy and lightweight definite, matrices for the immobilization of toxic and nuclear waste, both organic and inorganic.

Economic benefits of geopolymer concrete Heat-cured low-calcium fly ash geopolymer concrete offers several financial benefits compared to Portland cement concrete. The price of a ton of fly ash is only a small fraction of the cost of a ton of Portland cement. Therefore, after taking into account the amount of the alkaline liquids needed to manufacture geopolymer concrete, it is estimated that its price is between 10 and 30 percent cheaper than that of Portland cement concrete.

Alkaline activation can sometimes be a relatively cheap option compared to the use of conventional Portland cement (B.C. McLellan, 2011), especially in relatively remote locations that require the import

of cement (C. Sonafrank, 2010). Although sourcing activators can also be difficult in those regions, the volumes to be transported are reduced by a factor of around ten compared to importing cement, which has been found to offer advantages when an aluminum silicate raw material (e.g., fly ash from coal or other industrial by-products, or local soil of volcanic or clay origin) can be sourced locally.

Chemical Stabilization for pavements

The cost of building and repairing roads is often the most significant expense that governments must bear. The construction and maintenance of the routes require reliable and stable bases and sub-bases on which to put the surface that will be in contact with traffic. The long-term performance of a road often depends on the stability of the underlying soils (DN Little and S. Nair, 2009), and not providing adequate resistance to the road base leads to a lot of money having to be invested in repairing it to keep it up and running. The design of a track must ensure that each layer is capable of supporting and distributing the weight of the vehicles that circulate it. The bases must resist the excessive deformation that inevitably determines the rupture and fragmentation of the upper layers. Road construction generally requires compaction of the inner layers, which, depending on where you are building, are made of clay, gravel, weathered stone, and other related materials. In many cases, these are located on the ground where the construction of the road is carried out, but in others, it is necessary to transport them from other places, which implies higher costs (T. Maier, 2010). The transformation of native soils into appropriate soils for road construction can include physical and / or chemical processes.

The procedures are known and popular with civil engineers, but there is no universal solution due to the wide variety of soils and environmental conditions. The most common physical is mechanical compaction; this process achieves soil densification by decreasing the volume of air between the particles without appreciably modifying the water content (D. N. Little and S. Nair, 2009). This method is particularly effective on cohesive soils where the mechanical energy of compaction can cause reorganization and entanglement of the particles. However, the effect can be quickly lost due to fluctuations in the moisture content of the soil. The effectiveness of mechanical stabilization decreases as the fraction less than 75 μm becomes percentage greater, since the smaller the particle size, the more important are the surface forces that oppose changes in the soil structure. The alteration of the properties of the soil by chemical means and the subsequent application of mechanical energy is a more effective method to achieve the modification of the engineering properties of the land. Chemical stabilization is particularly useful in soils with more than 50% of its mass in the fraction less than 75 μm (D. N. Little and S. Nair, 2009)

6. METHODOLOGY

In order to carry out the stated objectives and respond to the research work, it was deemed necessary to program methods so that there are processes that lead us to a proposal for a successful master plan. The process that the urban network will generate can be summarized in terms of three principles. The three principles can be indicated as follows: Nodes: The urban system is based on nodes of human activity whose interconnections make up the network. There are different types of nodes: room, work, parks, shops, restaurants, churches, etc. Connections: The pairs of links are formed between the corresponding nodes, not as nodes. The pedestrian paths consist of short and straight sections between the nodes. Hierarchy: When allowed, the urban network self-organizes by creating an ordered hierarchy of connections at many and different levels of scale. It becomes multiply connected but not chaotic. Even sections similar to those included by the X-Team in CIAM X / Dubrovnik were analyzed, considering "urban planning as communities of various degrees of complexity" studied not in terms of a point but of a field of application, based on an exemplary diagrammatic approach. Derived from Patrick Geddes "Section of the Valley," who identified various types of "Scale of Association," ranging from the isolated house to the town, City, and City.

Figure 9.
Methodological scheme proposed in the design of the public transport network (authors, 2019).

Figure 10.
Diagram of whereabouts of the City of Guanajuato (prepared by Alan Cristian Cruz Ramírez. Direct observation of transport networks taken from Cruz Ramírez. 2018).

7. RESULTS

Sustainability or sustainable mobility is one capable of satisfying the needs of society to move freely, access, communicate, market, or establish relationships without sacrificing other current or future fundamental human or ecological values, without compromising the well-being of future generations (ISTAS, 2009). The transfer center has the sole function of providing a space where the user stays for a certain period, from the time you arrive at the plant to wait to board until you leave the plant towards your destination.
For this, the use of intermodal systems is necessary, that is, the knowledge of the already existing transport and its improvement, and the generation of new models of control, management, planning, and security; as well as the application of materials technologies to reduce the environmental impact in construction and methodologies that allow the development of intelligent intermodal transport in a global environment in cities, hence why it believed necessary to implement in the creation of intermodal stations recycled concrete, the use of geopolymers and the chemical stabilization of soils
During their life cycle, materials have a high impact on humanity and the environment. From the extraction of its raw materials, through its production, transport, commissioning, and final disposal, these impact the quality of life of all living beings that are somehow related to these material cycles. It is for this reason that, for the planning, design, construction, or renovation, operation, and final disposal phases of sustainable buildings, a careful evaluation of the construction materials to be used is required, as well as the possibility of your recycling. Being a fundamental factor in order to make a construction sustainable, the evaluation of the materials must be carried out in such a way that there is a complete integration of all the components of the building and its systems, so that they work integrally allowing the energy-saving, reducing the impact on the environment and providing quality internal environments for its occupants

8. CONCLUSIONS

It was seen that Guanajuato presents great conflicts in order to reach a quality in the sustainability issue; the closest way to solve is your transportation system, however, the change in your transportation system is still utopian in order to meet the standards. It is necessary to make constant studies, carry out more urban projects that are coordinated with each other. Above all, respect human dignity and invest the necessary costs. On the other hand, issues such as the distribution of public sectors throughout the city, and which is a method that has been carried out and is giving good results, are proposals that must be maintained and coordinated with new projects. It is certain that the municipality of Guanajuato will continue to have urban conflicts, whether they continue. Many spaces and architectural buildings have acted as accessibility barriers, despite fulfilling their main function, and do not allow enjoying the physical or social environment.

It is also very important that when creating spaces there is appropriation, allowing the population appropriates that space, and this will be achieved by granting identity, it is not only necessary to put some accessibility signs to indicate that this space is accessible but the configuration of the environment so that it speaks for itself and indicates the use and flow. The elements used in this research were: historical analysis, architectural surveys, photographic records, accessibility projects in Latin America and universal design manuals, in order to create a bank of projects. Allowing to conclude that everyone has the right to access any public space, under no visual limitations and / or physical barriers; and thus be able to include in the compulsory subjects in the Mexican Universities mainly with characteristics of a World Heritage city.

Regarding the use of materials and chemical stabilization of soils, we can conclude that chemical stabilization is used to improve the engineering properties of soils. Chemical soil stabilization consists of adding substances to the soil that modify the properties of the soil, which can be much cheaper than removing the soil to replace it with grit. Mechanisms of action may include: improvements in compaction, density, bearing capacity, aggregation of soil particles, reduction of soil susceptibility to changes in moisture content, reduction of the amount of water permeating the soil, soil waterproofing, decreased susceptibility to erosion or loss from traffic, wind or water.

Figure 11.
Diagram of whereabouts of the City of Guanajuato (authors, 2019).

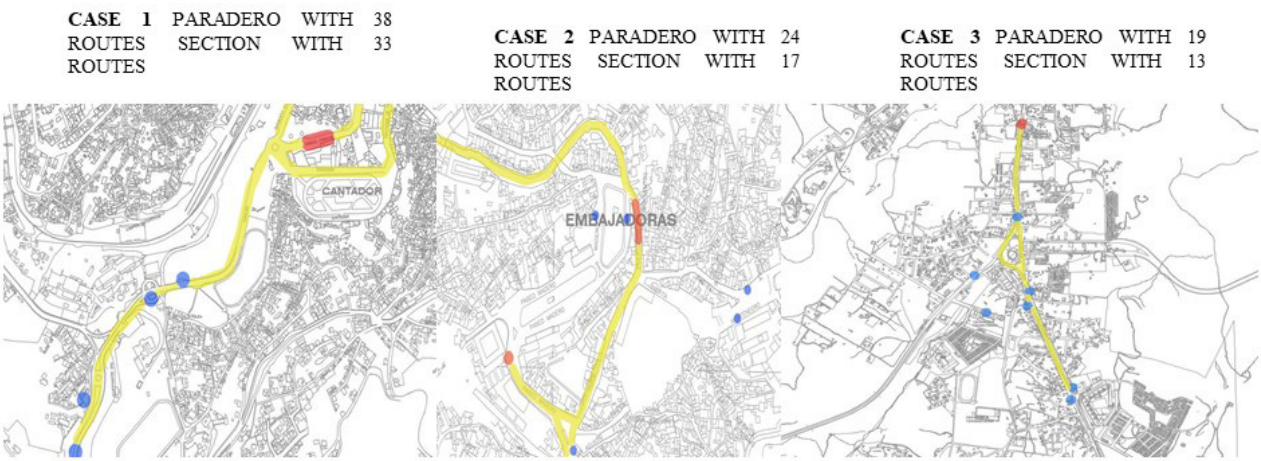

Figure 10.
Close proximity to the Central de Autobuses, the General Hospital of Guanajuato, the Los Alcaldes neighborhood and the direct exit to the municipalities of Irapuato, Silao and León
(Case 3. Cruz R. (2018) Thesis: The role of collective public transport in sustainable mobility in the historic center, Guanajuato, Gto. (1960-2017)).

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On the other hand, alkaline stabilization makes use of alkaline agents such as lime and cement. To a lesser extent, other alkaline agents are used, such as sodium or potassium hydroxide, silicates of the same metals, ash from vegetable products or from the combustion of coal, blast furnace slag and metakaolin. Lime and cement are the most common chemical stabilizers and have been used for many years, either in the form of the commercial product or as residues from its manufacture.

Another alkaline option is to go to the extreme, it consists of using strong bases such as sodium or potassium hydroxides. These strong bases are capable of attacking the silicates in the soil to form sodium silicate and aluminate that act in the same way as the sodium silicate discussed above. If the base amount and temperature are high enough or the reaction time is long enough, an amorphous three-dimensional network is formed similar to that of glass. The network incorporates aggregates from the soil; Those three-dimensional networks that under certain conditions can form zeolites (aluminosilicates with a crystalline structure) have been called geopolymers (J. Davidovits, 1994). The advantage of strong bases over sodium silicate is only that the most attacked particles are clays, which reduces their concentration and reduces the problem of expansion and contraction with humidity cycles. If the clay concentration is very high and the amount of hydroxide applied is not high enough, the same problems will arise as with sodium silicate. In any case it is possible to combine sodium hydroxide with sodium silicate for a faster and more effective action. The appropriate stabilization method will depend on the characteristics of the soil and the characteristics of the road.

Another group of materials traditionally used in soil stabilization are fly ash, which when mixed with alkaline agents can generate pozzolanic cementitious reactions, improving the characteristics of stabilized soils. Fly ash is rich in reactive amorphous silica and some of it is also rich in calcium. The ashes contain finely divided silica and alumina and in the presence of water react with calcium hydroxide to form calcium silicates and aluminates that act as cementitious material. The pozzolanic activity of ash depends on its composition, especially on the calcium content, and although some calcium-rich ashes harden in contact with water, in most cases it is necessary to add calcium oxide or hydroxide before hydrating them so that the hardening reaction develops. The physical and chemical characteristics of the ashes vary depending on the source, method and quality of combustion, and particle size. Fly ash is mainly composed of both amorphous and crystalline silica, with variable contents of aluminum, calcium, magnesium, potassium, sodium, iron, titanium and other metals, all in the form of oxides.

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