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Title: Urban Heat: Green Roofs to Decrease Solar Heat in Downtown Paraná

Introduction

Paraná is a quiet and peaceful city. Many people from bigger cities come here to relax and clear their minds. There is a lovely view to the river. The downtown of Paraná is also an area that attracts many visitors. It is situated in the Western and Northern sides of the city, and specially located around the areas of Primero de Mayo square and Government House of Entre Ríos.

Currently the downtown of Paraná city undergoes heat in the course of extended time periods, particularly in hot seasons: spring and summer. This is caused by decreasing green areas and vegetation, and because the growth of areas made of concrete and asphalt. These materials easily absorb solar heat and retain it along the mornings and afternoons.

The purpose of this presentation is to discuss the problem of heat in the center of the city of Paraná presented in spring and summer. I will also discuss green roofs as a proposal to address it, since due because of the characteristics this area has, it usually receives a significant amount of solar heat. What I am going to do is to discuss the causes and consequences of the heat in that area and offer a solution to this problem using green roofs in public buildings and to encourage their installation in private buildings as well.

To fulfil my purpose, first, I am going to use some images to describe and show some characteristics of the area I am focusing on. Next, I am going to present the problem. After that, I will use some images of the area to show the effects of the problem. Later, I will present the causes of our problem, and then also the consequences. After that, I am going to present my proposal to address the problem. Finally, I will analyze its positive and negative aspects.

Problem Definition and Analysis

Description of the Context

The downtown of Paraná is a very busy place. There are usually lots of cars parked and circulating. So there is also a lot of vehicular traffic, caused by cars, motorcycles, buses and even some bikes. For example, it's really hard to find a parking slot after 7 am. As a consequence, there is a lot of noise contamination and some pollution.



All around the area most of the buildings are average height, and they take up completely the front land space. There is no place for a garden, for example.

If we look at Tucumán Street, we could see many housing buildings, but also there are many shops along this way. Also, there is a school. Rivadavia school is on the corner of Tucumán and Cervantes streets. Tucumán is a narrow street, so there is a little space for the sidewalks.



On Alameda de la Federación street, you can feel a change of scenery. This is a wide road. The sidewalks are wider than those on Tucumán Street. This street is characterized by tree lines along both sides. There is a lot of tree shade there. On Alameda de la Federación, there are beautiful houses and some elegant commercial premises. There is a school too. Its name is Centenario School, a historical building. There is a square on the right side, which is behind the Government House.



Alameda de la Federación extends until Alvear square, where it becomes Colón Street. Opposite the square there is a tall church. Colón Street is a narrow road, traffic becomes complicated, but there are many trees along to shade the place. Also, there are some taller buildings on this route.



Salta street is another wide road so this is a fast way for car drivers. From Colón street to Urquiza street, we can see that there are many trees and vegetation on both sides of the road, but, beyond Urquiza street, this scene changes to a place without vegetation on narrow streets with narrow sidewalks.



As we have seen, in all these areas we only find vegetation and trees in the wide streets. But in the narrow streets, the roadways of the street occupy almost all the space leaving little space for the sidewalks and therefore there is no place for vegetation.

Problem Statement

The heat problem I am focusing on is in the downtown area, which is located in the area between Córdoba and Libertad Streets, to the west, and Belgrano and Salta Streets, to the east; and between Alameda de la Federación and Colón Streets, to the north, and Paraguay and Enrique Carbó streets, to the south. This area experiences very high temperatures over a long period of time in spring and summer. The causes of these high temperatures will be discussed later in this presentation.

Description of scenes that help picture the problematic situation

As it is difficult to illustrate the problem of high temperatures in pictures, I have taken some photos around the downtown to show the few spaces for trees and the small areas of vegetation that have remained; and also show the growth of constructions.

San Martín Pedestrian street



These two photographs were taken in the last stretch of the pedestrian street, between La Paz and Uruguay streets. They are focusing towards La Paz street. In both photographs, we can see some shops very close to each other to both sides.

The picture on the left was taken in 2011. It seems that it was taken early in the morning because the sun is in the East and there are any people on this street. In the center, there is a low tree with a large top. It is making a large shadow to its right.

The picture on the right was taken in 2019. It looks like it was taken in the afternoon because the sun is in the west, and there are some people walking. In the center of this image, we can see a couple sitting in coffee chairs. Behind them, there are some young palms. These palms can only give little shade, so the floor and walls heat up quickly.

This third photo is also from the same place but looking towards Uruguay Street, I mean, toward the other side. I think it was taken in the afternoon because the sun is in the west. On the left side of the photo, we can see many people walking on the shaded side of the pedestrian street because the sun must be high. The pedestrian path is not wide, and the confined space produced by nearby buildings obstructs wind circulation.



Primero de Mayo Square

This is a photograph of the 1° de Mayo Square. It focuses towards the San Martín pedestrian street. In the distance, we can see some shops. They are buildings of medium height, of one or two floors. In the middle of the photo there are two workers at that moment. To their left, there is excavated ground along the sidewalk. This is underground wiring, and it is going to be covered by floor tiles, because it needs to be accessible for future repairs. So, it will also extend the sidewalk while at the same time it is reducing the green space.

As we could see in the pictures, in the center of Paraná there is little presence of trees and



green spaces, but also the trees are removed to expand constructions. Consequently, the sun hits directly on houses, roofs and floors, that is, asphalt and cement.

Identification and analysis of causes or factors that give rise to the problem

The problem of high temperatures in the Downtown of Paraná in the warm seasons is caused by different factors.

The first of these factors is the construction of high-rise buildings. This means that, due to the growth of the city and the importance of the central area for work activity, and due to its proximity to shops and public buildings, it is the place where more people are concentrated. These constructions are made with materials such as bricks, concrete and asphalt. When they are exposed to sunlight, these materials absorb a lot of heat and retain it for a long time. This keeps the temperature high throughout the day.

The second reason for high temperatures is the reduction of green spaces. Due to the growth of constructions already mentioned, there is a decrease in green spaces. Even trees are removed for greater visibility and green spaces are also removed from sidewalks to standardize commercial walkways with concrete tiles.

A third reason is the use of air conditioners with outdoor units that emit hot air. These air conditioners remove the hot air inside the houses by ejecting it outside. Many people use air conditioners to cope with the heat so, on the hottest days, many of them work at the same time and expel the hot air into the street.

Identification and description of the consequences

There are some consequences of the problem of high temperatures. The most important is that it causes a decrease in the attendance of people in the area, which has a negative impact on the commercial, tourist and public activities. This is because people prefer to avoid doing activities or being



there from noon to late afternoon. For this reason, shopping, paperwork and other public activities must be concentrated during the early morning or late in the evening.

For example, in this picture along Laprida Street, we can see that there are no people circulating in the

area. Actually, it looks like a deserted street although it is an area with a lot of institutional and commercial activity.



Another additional consequence is the high energy cost consumed by the air conditioners in shops and offices locals. However, as we have already seen, its use actually aggravates the heat problem.

In these two pictures of the intersection of Italia Street and Peru Street, we can see that there are many air conditioners on the walls of the buildings along the street. The air conditioners have been marked with a red circle in all these pictures.

The Way Forward

Problem approach

As I have been able to show so far in this presentation, the problem of heat in downtown of Paraná is related to the high rate of construction and the reduction of spaces for vegetation. I understand that we cannot go back to those green spaces because it means interfere with the construction. For these reasons I think that one way to deal with higher temperatures is to introduce green roofs in public buildings, and encouraging neighbors to use it too, at the same time.

A green roof is an insulation construction method that uses vegetation on the roofs of buildings. It is made of a waterproofing geotextile membrane at the bottom and layers of organic and inorganic materials, where vegetation will be planted. The green roof will be used to receive the sun's rays through the roof areas. Soil and plants retain less heat than cement materials, so green roofs lower the surrounding ambient temperature. Besides it works as a good thermal insulator for the buildings, so it should reduce the use of air conditioners as well.

Strengths and Weaknesses of the Proposal

Green roofs have some weaknesses. First, they need constant care, plants must be watered and care for decaying organic matter that can clog the filtration of raised beds and produce unpleasant odors. Second, green roofs require some structural features of buildings because they add a lot of weight to the roof. And thirdly, green roofing facilities are expensive because they require an investment to get those structural features, on the one hand, and to buy materials like fertile soil, organic substrate and the appropriate type of vegetation in accordance with the local weather conditions, on the other. Basically, they are expensive because they require a large investment.

However, green roofs have some strengths and benefits too. First, they are a middle-term action to deal with the lack of spaces in a city center. Secondly, they are eco-friendly and they also have a positive influence on the surrounding weather and nature. Thirdly, green roofs can absorb rainwater, and download it slowly, so they could help to avoid flooding. Finally, the fact that green roofs require garden maintenance can be an opportunity for job creation.

Conclusion

Final Statement

In conclusion, as we could see there is a heat problem in the center of Paraná, which worsens in the spring and summer seasons. This problem can be seen in the decrease in the number of people on its streets until the sun goes down and it gets dark. The problem of heat affects the tourist, commercial and public activities of the area. The causes of high temperatures in the area are the high pace of construction and the reduction of green spaces and vegetation to make roads, widening sidewalks and pedestrian paths. In this way, there is a greater surface of cement and asphalt exposed to the sun's rays, absorbing the solar heat.

For these reasons, the proposal to install green roofs in public buildings aims to address the causes of the problem. The proposal is a good way to achieve this, as it only focuses on public buildings, without interfering with private buildings or properties, but at the same time it is intended to encourage their use among neighbors. Although it is an expensive solution, it takes care of natural resources and it benefits the natural environment.