

Infrastructure in Poor Condition: Reconstruction and Maintenance of Potholes at the Corner of Francia Street and Rio Negro Street in Paraná City

Tanya Muller¹ – Sofia Sattler² – Ana Paula Tomassi³

*Civil Engineering Department, Facultad Regional Paraná, Universidad Tecnológica Nacional
1033 Almaguero Av, Paraná Entre Ríos, Argentina*

¹ tanyamuller@alu.frp.utn.edu.ar

² sofiasattler@alu.frp.utn.edu.ar

³ anatomassi@alu.frp.utn.edu.ar

Summary— Potholes in a city reveal inadequate construction and lack of maintenance. These problems are frequent in various areas of the city of Paraná, contributing to the widespread problem of potholes. Although potholes are found throughout Paraná, in this work the focus is on a specific street in the city. The presentation aims to address the problem of a pothole located at the intersection of Francia Street and Río Negro Street in Paraná. To fulfil this aim, this work suggests using polymeric materials, specifically geogrids, to enhance the street surface, offering a practical and thoughtful solution to the problem. This is the way that this work is organized. First, the context of the city area that is the focus of this work will be described, followed by a description of pictures that show the area where the problem is located. Next, the problem will be stated, analysing its causes and consequences. Then, a possible solution will be presented to solve the problem. Finally, the positive and negative aspects of the proposal will be addressed. This work offers a replicable and sustainable solution to address the pothole issue in cities like Paraná. This solution aims to improve road safety, reduce repair costs and vehicle damage, and enhance the well-being and safety of the local community.

Keywords: geogrids, pavement, potholes, repair

Resumen: Los baches en una ciudad revelan una construcción inadecuada y falta de mantenimiento. Estos problemas son frecuentes en diversas zonas de la ciudad de Paraná, contribuyendo al problema generalizado de los baches. Si bien los baches se encuentran en todo Paraná, en este trabajo el foco está en una calle específica de la ciudad. La presentación tiene como objetivo abordar la problemática de un bache ubicado en la intersección de las calles Francia y Río Negro en Paraná. Para cumplir con este objetivo, este trabajo sugiere el uso de materiales poliméricos, específicamente geomallas, para mejorar la superficie de la calle, ofreciendo una solución práctica y reflexiva al problema. Así es como se organiza este trabajo. En primer lugar, se describirá el contexto del área de la ciudad que es el enfoque de este trabajo, seguido de una descripción de imágenes que muestran el área donde se encuentra el problema. A continuación, se enunciará el problema, analizando sus causas y consecuencias. Luego, se presentará una posible solución para resolver el problema. Finalmente, se abordarán los aspectos positivos y negativos de la propuesta. Este trabajo ofrece una solución replicable y sostenible para abordar el problema de los baches en ciudades como Paraná. Esta solución tiene como objetivo mejorar la seguridad vial, reducir los costos de reparación y los daños a los

vehículos, y mejorar el bienestar y la seguridad de la comunidad local.

Palabras clave: geomallas, pavimento, baches, reparación

I. INTRODUCTION

Potholes in a city reveal inadequate construction and a lack of maintenance. These issues are frequently common in various areas of the city of Paraná, contributing to the widespread problem of potholes. Although potholes are found all around Paraná, in this presentation, the focus is on a specific street in the city.

The purpose of the presentation is to address the problem of a pothole located at the intersection of Francia Street and Río Negro Street in Paraná. To fulfil this aim, a solution that involves the repair and maintenance of this pothole in the affected area will be described.

In order to achieve the above stated purpose, this is the way that this work is organized. First, the context of the city area that is the focus of this work will be described, followed by a description of pictures that show the area where the problem is located. Next, the problem will be stated, analysing its causes and consequences. Then, a possible solution will be presented to solve the problem. Finally, the positive and negative aspects of the proposal will be addressed.

This work offers a replicable and sustainable solution to address the pothole issue in cities like Paraná. This solution aims to improve road safety, reduce repair costs and vehicle damage, and enhance the well-being and safety of the local community.

II. PROBLEM DEFINITION AND ANALYSIS

A. Description of the Context

Paraná is the capital city of the province of Entre Ríos. It has 1,426,426 inhabitants. The city is divided into five zones (Fig. 1.). The problem area is located in the southeast zone, specifically in Universitario neighborhood, between Francia Street and Rio Negro Street, as can be seen in Figure 2.

> THIS IS AN ENGLISH AS A FOREIGN LANGUAGE ENGINEERING STUDENT PAPER. READERS MAY MAKE USE OF THIS MATERIAL AT THEIR OWN DISCRETION<



Fig. 1. Areas of Paraná.

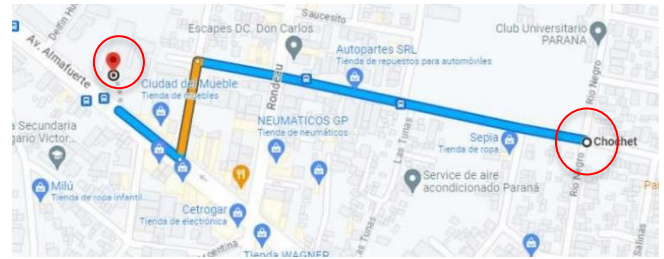


Fig. 4. Distance from the pothole in Universitario neighborhood to UTN.

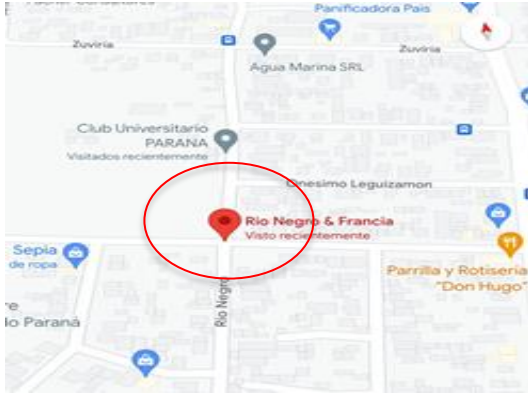


Fig. 2. Intersection of Francia Street and Río Negro Street.

Francia Street is an urban and busy area. In this area, there are many houses, markets and institutions. There is a little vegetation because there are lots of buildings and a lot of garbage on this street. At the end of Francia Street, there is a factory called Cotapa (Fig. 3.). It emits a lot of smoke so it produces pollution.



Fig. 3. Cotapa factory on Francia Street.

On Río Negro Street, there is the entrance to Universitario Club. This club offers some activities like football, volleyball, boxing and social events. The problem that is addressed in this presentation, the potholes, is located next to Universitario Club and 200 meters away from Universidad Tecnológica Nacional Facultad Regional Paraná (UTN FRP) (Fig. 4.)

B. Problem Statement

The problem of potholes in various streets of Paraná seems to be eternal. This city, in comparison to other cities in the province, has a high percentage of its streets in deplorable conditions. The municipality of Paraná has carried out more than 5,000 pothole repairs so far this year, using around 7,500 tons of asphalt, making a high investment. However, these repairs were not executed correctly causing other problems.

The issue addressed here is a pothole in Universitario neighborhood. As mentioned before, this pothole is at the intersection of Francia Street and Río Negro Street. It has a dimension of 2.16 x 0.80 meters, causing pronounced flooding in that corner. It has undergone many repairs but, as we mentioned before, the lack of maintenance is a critical factor in this problem and proper maintenance has never been carried out correctly.

C. Description of Scenes that Help Picture the Problematic Situation

Figure 5 shows the problem. As you can see, the pothole is located in a corner and is filled with water. This situation is very worrying and requires a solution to guarantee the time, safety and well-being of those who want to travel along this street.



Fig. 5. Pothole filled with water on Francia Street.

Figure 6 shows the big size of this road surface depression, which is filled with standing water. In the background of the photo, it can be seen that there is a group of neighbours waiting for the bus, which is experiencing a delay in completing its route along Francia Street due to the lack of pothole repair.

> THIS IS AN ENGLISH AS A FOREIGN LANGUAGE ENGINEERING STUDENT PAPER. READERS MAY MAKE USE OF THIS MATERIAL AT THEIR OWN DISCRETION<



Fig. 6. Illustration of the pothole on Francia Street.

D. Identification and Analysis of Causes or Factors that Give Rise to the Problem

Several important factors play a role in the development of potholes. The causes for the pothole at the intersection of Francia Street and Río Negro Street are:

- Extreme weather
- Heavy traffic and wear
- Lack of maintenance

The extreme weather conditions that are experienced in Paraná produce very noticeable changes in the environment. During cold winters, water can infiltrate cracks in the pavement. When this water freezes and then thaws, it expands and weakens the pavement (Fig. 7).



Fig. 7. Impact of extremely low temperature on pavement quality.

The very high temperature also affects road works. When creating pavement, the softening point must be taken into account since once that point is exceeded, the asphalt will begin to deform. Both extreme climates can produce deformations in pavement that can lead to the formation of potholes (Fig. 8).



Fig. 8. Impact of extremely high temperature on pavement quality.

In relation to heavy traffic in this area, the constant, flow and heavy loads of vehicles, especially commercial ones, can affect pavement by causing wear and erosion, which lead to the formation of potholes. Heavy-load commercial vehicles are very frequent on Francia Street so the formation of new potholes is very common (Fig. 9).



Fig. 9. A bus as an example of a heavy-load commercial vehicle.

The lack of regular pavement maintenance is a third cause for this problem. The absence of crack filling or surface sealing, can lead to the infiltration of water and other elements into the pavement structure. When water enters the upper layers, the asphalt binder separates from the stone aggregate, generating potholes more easily (Fig. 10).



Fig. 10. Pavement maintenance.

E. Identification and Description of the Consequences

The presence of a huge pothole in this area has three main consequences. These are:

- Road safety concerns
- Repair costs
- Damage to vehicles

In the first place, this pothole presents a road safety risk. It can be a serious threat due to the possibility of causing accidents involving vehicles and pedestrians, especially if drivers try to swerve abruptly to avoid it due to poor traffic signage there. (Fig. 11).

> THIS IS AN ENGLISH AS A FOREIGN LANGUAGE ENGINEERING STUDENT PAPER. READERS MAY MAKE USE OF THIS MATERIAL AT THEIR OWN DISCRETION<



Fig. 11. Poor signage.

In the second place, repairing potholes is expensive for road authorities and also for taxpayers. The state must allocate financial resources and manpower to maintain pavements in safe and drivable conditions (Fig. 12).



Fig. 12. Budget agreement.

France Street is very travelled by trucks through to Cotapa factory, therefore the size of the pothole intensifies. This is a real concern for drivers, as it can cause a series of significant damages to vehicles. These range from simple annoyances like vibrations and noises to more serious problems like flat tires and misaligned wheels. Furthermore, it not only affects the visible components of the vehicle, but can also trigger more complex mechanical problems in the suspension and steering system. These problems cause a decrease in the stability of the car, endangering the safety of passengers. (Fig. 13).



Fig. 13. Vehicle's Safety Hazard because of this pothole.

A. Problem Approach

The proposed solution will consist of the use of polymeric materials for the resurfacing of the street. The use of polymeric materials consists of the addition of polymers to asphalt in order to improve its mechanical properties. Although there are many available materials, we opted for the geogrids (Fig.14).

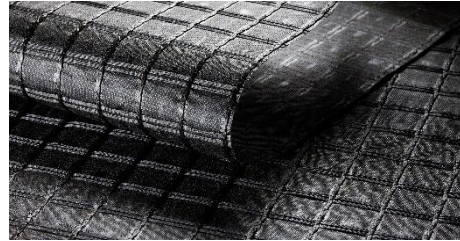


Fig. 14. Geogrid for resurfacing.[1]

In relation to geogrids, they can be described as structures of flat, orthogonal and open meshes. They are made up of synthetic woven filaments (polyester, polypropylene, polyamide or polyvinyl alcohol) with a polymeric coating, suitable for resisting high tensile stresses [2].

Geogrids are a widely used material with multiple benefits, including:

- Extension of maintenance intervals
- Extension of useful life of pavements
- Reduction of maintenance costs
- Durability of more than 40 years

Geogrids can only be applied to flexible pavements; which are constructed using one or several asphalt layers and/or selected or treated materials with depth. The structural package of such pavements comprises four layers (Fig. 15):

- Asphalt layer: This forms the road surface and consists of a mixture of stone aggregates and asphalt, with the latter being the foundation for this type of pavement.
- Base: Its main function is to transmit and distribute the loads from the pavement to the lower layers, which include the subbase and subgrade.
- Subbase: It is a granular layer that acts as a filter so that particles of fine material that could damage the subgrade are not introduced.
- Subgrade: It is the starting level of the structural package, which is, in turn, the earthwork level of completion prior to the construction of the structural package.

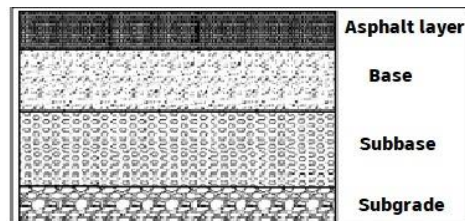


Fig. 15. Structural package layers.

III. THE WAY FORWARD

Geogrids are applied above the base. Their application is simple and effective, no specialized personnel are needed.

> THIS IS AN ENGLISH AS A FOREIGN LANGUAGE ENGINEERING STUDENT PAPER. READERS MAY MAKE USE OF THIS MATERIAL AT THEIR OWN DISCRETION<

The surface is required to be in standard condition. Between the layers of asphalt, it must be clean, dry and free of loose material. The surface must be uniform, and in this case, the upper layer of asphalt must be milled to guarantee good adhesion of the geosynthetic.

The application of geogrid cloths is an organized process, which follows several key steps for effective installation. These steps are:

- Step 1: First the pavement milling is carried out and then the existing cracks are sealed (Fig.16).



Fig. 16. Pavement milling.

- Step 2: The surface is treated with a bitumen-based glue, as seen in Figure 17, before geogrid installation.



Fig. 17. Garter irrigation.

- Step 3: Geogrids are extended and secured using steel nails and washers, which should not be separated by more than 1 m apart to guarantee their fixation.
- Step 4: Joints between reinforcing steel bars are secured allowing a 10cm longitudinal extension and a 15cm transverse extension.



Fig. 18. Geogrid Collation.

- Step 5: The surface is cleaned prior to priming, and a layer of glue is applied on the geogrids (Fig. 18).
- Step 6: A layer of asphalt is placed over the geogrids to protect the mesh from possible damage that may be caused by the covers of the machinery and equipment (Fig.19).



Fig. 19. Asphalt venting.

- Step 7: The asphalt is installed as shown in Figure 20.



Fig. 20. Final Asphalt Installation.

- Step 8: The thickness of the asphalt is verified since the geogrids must be protected by a layer of no less than 8cm.
- Step 9: The final compaction of the asphalt is also carried out to leave it ready for safe use.

In summary, the careful geogrid cloth application process guarantees the pavement's durability and safety. Each step, from preparation to finalization, is vital for a long-lasting and secure road surface.

B. Strengths and Weaknesses of the Proposal

In this project, the use of polymeric materials is chosen because they are evaluated as the most feasible option for several reasons:

- Polymeric materials, such as geogrids, have a long useful life due to their molecular and atomic composition.
- They can withstand intense traffic because they have high tensile strength which makes them very efficient in the use of pavements.
- They are waterproofing of the asphalt layer so they make it possible to separate the layers without water seeping into them.
- They replace traditional pothole repairs, being a more durable and sustainable option. However, polymers are not entirely sustainable but they become a more environmentally friendly option than traditional pothole repairs that must be carried out more frequently.
- They delay the appearance of cracks because they receive all the loads and distribute them throughout the pavement, avoiding cracks.

The use of polymeric materials also have negative aspects that should be considered. Among the most relevant weaknesses of carrying out this proposal, it can be mentioned that:

> THIS IS AN ENGLISH AS A FOREIGN LANGUAGE ENGINEERING STUDENT PAPER. READERS MAY MAKE USE OF THIS MATERIAL AT THEIR OWN DISCRETION<

- They impact the environment because they are manufactured industrially so they produce waste that takes 100 years to degrade.
- They are very expensive since they are imported.

As we can see, there are many more positive aspects than negative ones, which is why we chose this solution as the most convenient one to be used in this situation.

IV. CONCLUSION

In conclusion, this presentation not only highlights the critical problem of potholes in Paraná, but also refers to a viable and effective solution through the implementation of polymeric materials. The proposed approach shows a solution that not only addresses the road-related challenges but also extends into the social field; offering a promising approach to address this widespread problem in the city.

Tanya Muller is a Civil Engineering student at UTN FRP: tanyamuller@alu.frp.utn.edu.ar. Sofia Sattler is a Civil Engineering student at UTN FRP: sofiasattler@alu.frp.utn.edu.ar. Ana Paula Tomassi is a Civil Engineering student at UTN FRP: anatomassi@alu.frp.utn.edu.ar.

The present project is a skills integration activity in Inglés I at Universidad Tecnológica Nacional, Facultad Regional Paraná, carried out by EFL engineering students. The yearlong project requires students to delve into a problem in the city where they live and to address it by means of a simple project in English. Should the reader have any questions regarding this work, please contact Graciela Yugdar Tófaló, Senior Lecturer, at gyugdar@frp.utn.edu.ar.

ACKNOWLEDGMENT

The authors would like to thank Edith Mercaich Sartore for her collaboration in the writing of this project.

REFERENCES

- [1] “Refuerzo Asfáltico,” Coripa. <https://coripa.com.ar/refuerzo-asfaltico/> (accessed Oct. 13th, 2023).
- [2] “HaTelit® C - Cirtex,” Aug. 11, 2021. <https://cirtexcivil.co.nz/products/pavement-surface-reinforcement/hatelit> (accessed Oct. 12th, 2023).