

# Draining Half-Wire with Bamboo Fibers applied in the Search of Reducing Damage Occasioned to Asphalt in the City of Rialma

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**Abstract**— Some construction problems are related to hydrology. Water, whether it comes from precipitation or from homes, is always creating challenges for engineers. Residential water, used and subsequently discarded from households to the streets, even if they do not seem to be a hindrance, as it does not drain into the usual drainage means, thus forming concentrations of water that in the long run tend to damage the asphalt. It was thought of a solution for this that the draining curb was idealized, with the objective of becoming a mechanism in the drainage system that helps, and, solve these problems that may seem small, but end up causing inconvenience. As a proposal for a sustainable material that adds quality, the bamboos of the Imperial and Taquara species were included in a prototype of draining curb tested in the laboratory to determine the best proportion of addition of this material to indicate the most suitable concrete for the preparation of the prototype.

**Keywords**— Urban Drainage. Curb. Bamboos. Sustainability.

## I. INTRODUCTION

The city of Rialma-Goiás, located on the banks of the BR-153, has undergone changes in its urban space, since its emancipation by the growth of the habitable area. The expansion of urban space has generated demands for infrastructure that have rarely been realized. Proper city planning provides for risks that can be avoided, an example of which is the rainwater drainage system. An adequate drainage system unites all the mechanisms of urban infrastructure for the proper conduct of wastewater.

The city of Rialma has often experienced difficulties because most of it has a deteriorated asphalt pavement due to the absence of an adequate drainage system to support the inserted flow. The need to drain the water discharged on the city streets provided the search for different means of driving; the curb is an example present in the urban infrastructure that can be used to carry out drains from homes to the drainage system along the

channels, avoiding wear and tear in the moisture on the asphalt.

Therefore, a draining curb with bamboo fibers was developed in order to reduce the damage caused by the flow of water from homes with a focus on the area in front of the garages, which is usually where the water that damages the asphalt flows. We wanted to demonstrate the reality of the municipality of Rialma in relation to the drainage system, estimate the damage in the asphalt resurfacing and make a proposal to adapt a curb that helps in the flow of liquids and reduces the asphalt degradation with the best addition among the bamboo species studied.

## II. METHODOLOGY

Data were collected from a field study to understand the existing drainage system and the drainage system being implemented, and damage to the asphalt possibly caused by the inefficiency of the existing drainage

system was observed. Proceeding with searches in bibliographic references with qualitative character in articles and projects in development process provided by the city hall of Rialma.

In the research on bamboo to assist in the elaboration of a curb capable of adding quality, experiments were carried out in the laboratory in order to create a draining curb. The extraction of the fiber from this material was carried out by scraping and grinding. Another relevant aspect was the design of the curb shape, in the AutoCAD software, seeking to allow the passage of water and adaptation to the drainage system.

### III. RESULTS AND DISCUSSION

The disordered occupation of urban areas and the consequent coverage of large areas of the soil, cause an increasing reduction of rain infiltration, thus an effective drainage system is extremely necessary, because in addition to helping to solve these problems, it will channel part of water in order to redirect the external flow to the internal drainage system. According to TUCCI (2003, p. 36) the urban drainage policy is based on draining the precipitated water in the best possible way, but the abandonment of this principle in the 70s caused immediate consequences such as the increase in floods.



(A)



(B)

Photo1 (A): Deterioration of 32nd Street. Photo1 (B): Deterioration of 29th Street.

Source: Authorship. Source: Authorship.

Rialma goes through the process of installing urban drainage that does not exist in almost all sectors. The city is located in mountainous terrain, measures for dimensioning the drainage system are necessary. The roads, which are significantly damaged, have hindered the daily life of the population, whether in traffic, material damage due to wear on the sidewalk or even by flooding in houses (photos 1A, 1B).

The absence of an efficient drainage system, in addition to causing damage to asphalt, gives society diffuse pollution that is generated by runoff in urban areas from the disposal of pollutants (BRITES, 2005, p.65), as waste emitted by the population and launched on the roads. The problems due to the absence of an adequate drainage system show its relevance, according to data from the Brazilian Institute of Geography and Statistics (IBGE), the city has only 2.1% of urban households on public roads with adequate urbanization.

The city is in the late stages of building the drainage system, which is mostly present in the central sectors of the city. The need for methods to reduce damage to city roads is evident. The curb is a device capable of reducing such damage, as it assists in driving and redirects liquids, as it has a rectangular or trapezoid shape, there may be gutters and water inlets through which the inserted discharges are conducted (ROCHA, 2006, p. 4).

The curb prototype was dimensioned 50 cm long and 30 cm high, with 3 40 mm diameter holes for water inlet and a 100 mm pipe to drain all the liquid. The volume of the prototype was approximately 28.2 liters. Materials such as metal plate, wood and expanded polystyrene (EPS) were used to manufacture the form. Bamboo was used to add water resistance and absorption to the draining curb; the species used to define the best result of the molds were Taquara and Imperial.

The structural composition provides bamboo stems with a high physical-mechanical resistance, lightness, flexibility and discrepancies according to the species, hence the relevance of studying different species to analyze variations according to their characteristics (BRITO et al. 2015, p. 560). Other materials used and their measurement ratios were cement with 25.74%; gravel 0 and gravel 1 with 61.13%; additive with 0.26%, and water with 12.87% and 5% Imperial bamboo. The mass ratio was 1: 3. The process of elaborating the curb can be demonstrated in Figure 1.

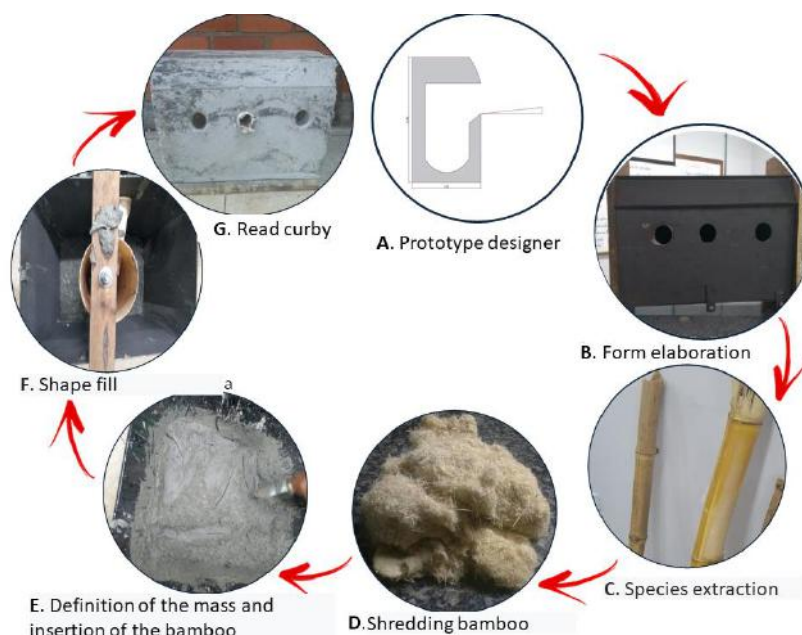


Fig.1: Curbdevelopment.

The compressive strength test allowed to verify the strength of the bamboo, with Imperial bamboo with an external diameter of 70 mm having a resistance of 24.45 MPa, while Taquara bamboo with an external diameter of 45 mm had a resistance of 27.86 MPa. According to the National Department of Transport Infrastructure (DNIT) 020/2006 the concrete for the curb must have a minimum compressive strength (fck) at 28 days of 15MPa. It was decided to use Imperial bamboo to observe the bamboo's ability to add quality. The test with the specimens was carried out in cylindrical molds, at 8 days, the specimen without bamboo had a resistance of 16.92 MPa and the specimen with bamboo, a resistance of 13.20 MPa, and, at 16 days, the specimen without bamboo showed a resistance of 14.71 MPa and with bamboo a resistance of 14.84 MPa.

For the water absorption tests the cylindrical specimens were immersed in a bucket of water for 30 minutes, tests were carried out on specimens calculated in volume, with 10% bamboo that obtained absorption of 22.4g of water, 20 % of bamboo with absorption of 41.3g of water, 30% of bamboo with absorption of 52.5g of water and 40% of bamboo with absorption of 67.6g of water, verified that the greater the addition of bamboo in the mass, the greater the water absorption in concrete.

#### IV. CONCLUSION

It is essential to have methods that reduce the accumulation of fluids in the streets, the draining curb for containing a diameter of 100mm allows a flow of up to 8L / s which significantly reduces the amount of water installed on the asphalt pavement. The tests carried out

with Imperial bamboo made it possible to verify that it is possible to aggregate greater water absorption and resistance to the material, the lightness that bamboo can provide also stands out because the more bamboo added to the concrete, the material becomes even lighter. The bamboo draining curb is a proposal for the drainage system capable of adapting the quality and better water targeting of the system, allowing the reduction of water in the asphalt pavement, and, consequently, streets less prone to deterioration.

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