



Estudo de caso do projeto e execução do sistema de drenagem do gramado de futebol do Estádio Bezerrão

Case study of the design and execution of the drainage system for the soccer pitch at Bezerrão Stadium

DOI: 10.56238/isevmjv3n2-018

Receipt of originals: 22/02/2024

Publication acceptance: 03/12/2024

Rideci Farias¹, Heuber de Freitas Silva², Haroldo Paranhos³.

ABSTRACT

In football stadiums, every aspect is important. Infrastructure, bleachers, locker rooms, artificial lighting and, without a doubt, the turf that is vital for the games to take place without obstructions and risks. One of the problems that causes the reduction in gameplay; These are puddles, that is, the waterlogging of the lawn caused by rainwater. This problem is common in Brazil due to the tropical equatorial climate, which is characterized by high temperatures and intensity of rainfall, the latter being caused, in some situations, by cancellations of games with inconvenience to fans and spectators and even delay in championships. Another problem generated by the excess of accumulated water is the damage to the health of the lawn, as poor drainage prevents the correct development of the root system due to the lack of oxygen in the soil, limiting the absorption of nutrients, important for the development of the lawn, and hindering the process of maintenance and trimming of the grass. Within this context, the drainage system in a soccer field is paramount. This system is divided into superficial and subsuperficial. Therefore, this paper presents and discusses the drainage system of the soccer field of the Bezerrão Stadium, located in the Administrative Region of Gama, Federal District.

Keywords: Federal District, Gamma, Calf, Soccer Field, Drainage.

INTRODUCTION

This article presents the study and execution practices carried out in the construction process of the drainage system of the Bezerrão Stadium soccer field, located in the Administrative Region of Gama, Brasília - Federal District. The drained field has dimensions of 121m x 83m. The design and execution began in 2007 and was divided into two stages. The

¹ D. Sc.

UCB / CEUB, Brasília/DF, Brazil

E-mail: rideci.farias@gmail.com

² B. Sc.

CEUB, Brasília/DF, Brazil

E-mail: heuber.freitas@sempreceub.com

³ M. Sc.

CEUB / Reforsolo Engenharia, Brasília/DF, Brazil

E-mail: reforsolo@gmail.com

conventional anal solution chosen for the treatment of the sub base and base has as a component the drainage geocomposite MacDrell TD 2L.

INITIAL CONSIDERATIONS

For the development of this article, there was a need for a broad bibliographic survey that could represent the knowledge about the region where the system was implemented and the most efficient method. Next, we present, mainly, geological-geotechnical issues related to the Gama region (DF).

ADMINISTRATIVE REGION OF GAMA/DF

The Administrative Region of Gama, like the others, was created to house the population due to the construction of Brasília, and the so-called satellite cities were created, according to Law 3751 of April 13, 1960. Figures 1 and 2 show the location of the Gama Administrative Region, located in the Federal District (DF).

Figure 1 - Location of the Administrative Region of Gama/DF (GOOGLE MAPS, 2020).

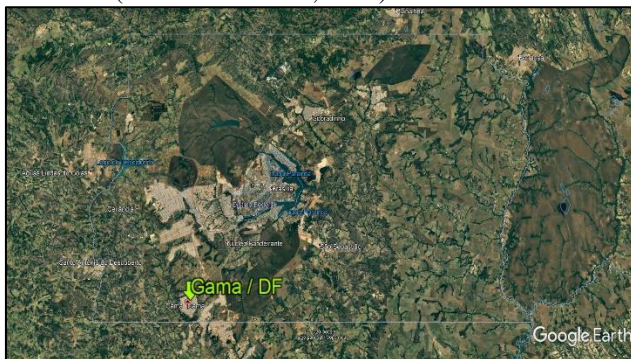


Figure 2 - Administrative Region of Gama/DF (<https://www.google.com/maps/place/Gama>).



Climate of the Region

The climate of the Administrative Region of Gama, which is similar to that of the Federal District, is characterized by two distinct periods: a dry one, with almost total absence of rainfall, in winter, which lasts from May to September, and a rainy one that goes from October to April, with an annual rainfall that exceeds 1,560 mm. The average annual temperature is close to 21° C, with the months of September and October being the warmest, with June and July the coldest. The average annual relative humidity is 55%, but in the driest months, July and August, it reaches an average of 18%, a number that due to low air humidity and almost absence of rain can reach desert levels. (<https://pt.climate-data.org>).

SOILS OF THE FEDERAL DISTRICT

Most of the soils in the Federal District are characterized by porous soils with a thickness of more than 10 meters. Due to the various processes that occurred in its genesis, this cover presents peculiar characteristics and distinct geotechnical behavior. This soil is very susceptible to erosion, and gullies appear in urban settlements, highways, and loan areas (FREITAS-SILVA; CAMPOS, 1998).

Among the classes of soils that occur in the Federal District, the main ones are presented and described in the work of reclassification of soils of Embrapa (2004) in which there are latosols and cambisols with an approximate sum of 85.48%. Figures 3 and 4 show, respectively, the geological and soil maps of the Federal District.

Most of the soils in the study region are acidic and have low fertility, predominantly B horizon soils of the cambic, latosolic and textural types, as well as some patches of hydromorphic soil and, to a small extent, alluvial soils located in the lowlands on the banks of streams (FARIA, 1995).

Figure 3: Geological map of the Federal District (CODEPLAN, 2017).

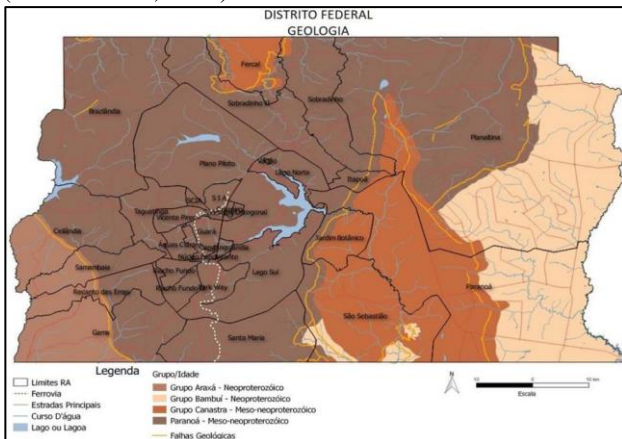
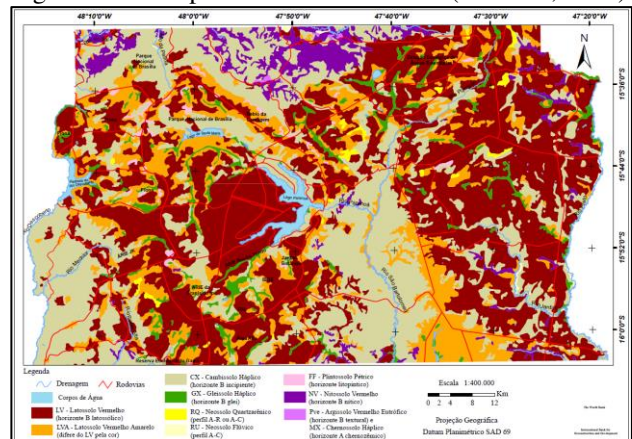


Figure 4 Soil map of the Federal District (ADASA, 2019).



AREA OF INSECTION OF THE DEVELOPMENT

The insertion area of the project under study is located in the central portion of the Administrative Region of Gama/DF. In this place, the land is made up of red latosols of the Paranoá Group.

The Walmir Campelo Bezerra Stadium (Figures 5 and 6), known as Bezerrão, is a multi-purpose stadium usually used for soccer matches. Inaugurated on October 9, 1977, it has undergone several improvements, one of which took place in 2008 and is the subject of this article. The installation of a drainage system on the arena's 121m x 83m lawn. The stadium has a

capacity for 20,000 spectators. It is managed by the Federal District Government and is where Sociedade Esportiva do Gama usually plays its matches.

Figure 5 Aerial view of the Bezerrão Stadium (GOOGLE MAPS, 2020).



Figure 6 Aerial view of the stadium (Wikipedia.Org, 2020).



CHARACTERISTICS OF THE DRAINAGE SYSTEM

The work in question has an area of 10,043m² of football turf. At the time, studies were carried out that pointed out a deficiency in the drainage flow with several problems that impaired the quality of the grass due to the accumulation of water in the lawn from rainwater, preventing the correct development of the root system that allows the soil to better oxygenate and absorb the nutrients vital to the development of the grass with considerable increases in the cost of maintenance.

Due to the inefficient drainage system, in December 2007, the lawn underwent analysis with soil tests that would serve for the preliminary design of the basic project.

With the results of the tests carried out in that period, the new system was developed in two stages with analyses in the respective layers: superficial or base layer and subsurface or sub-base layer.

The surface drainage system takes place in the base layer given by the drape imposed on the terrain in the execution of the earthworks with a recommended average slope of 0.5% for a good drainage of precipitated water, but also so that the field is not excessively bulging.

Subsurface drainage is the non-visible drainage, built in the sub-base, present under the lawn, it is hidden from the eyes of spectators. However, it is primarily responsible for preventing waterlogging. This drainage is usually composed of draining mattress and drainage trenches.

Commonly, the draining mattress is the composition formed by a layer of sand and organic matter that is used for planting grass. It is common for the thickness to vary from 20 to

35 cm and its purpose is to quickly remove the water that drains superficially and direct it to the drainage trenches. Figure 7 shows a very common system in field drainage with a path through which the water drains.

Figure 7 Image of the runoff with the direction of the water.

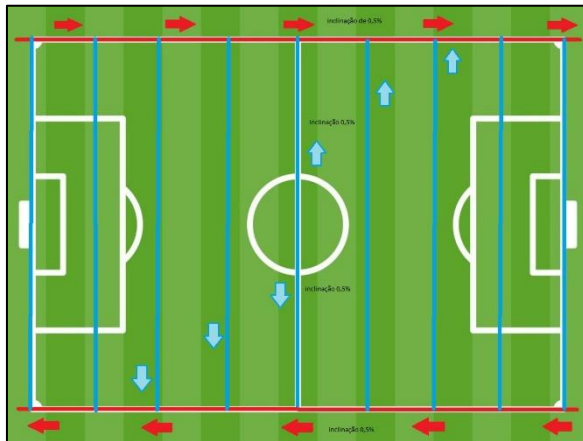
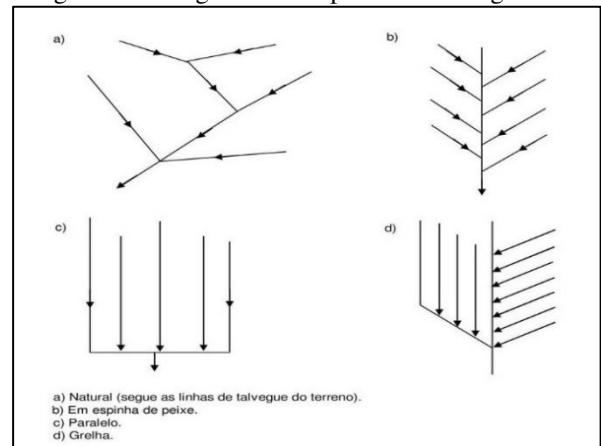


Figure 8. Configurations of possible drainage lines.



SYNTHETIC DRAINS

Replacing the older methods and/or in combined use, there is the synthetic drainage system that is capable of capturing, conducting and draining excess water from rainfall, the irrigation system, lowering the water table, among other applications, with greater efficiency and speed, presenting a series of technical, constructive and economic advantages in relation to conventional systems. The installation is extremely simple and practical and already has a built-in bag with a guide for packing the drain pipe (purchased separately). Figures 9 and 10 show, respectively, a draining geocomposite system and the illustrative schematic drawing already installed.

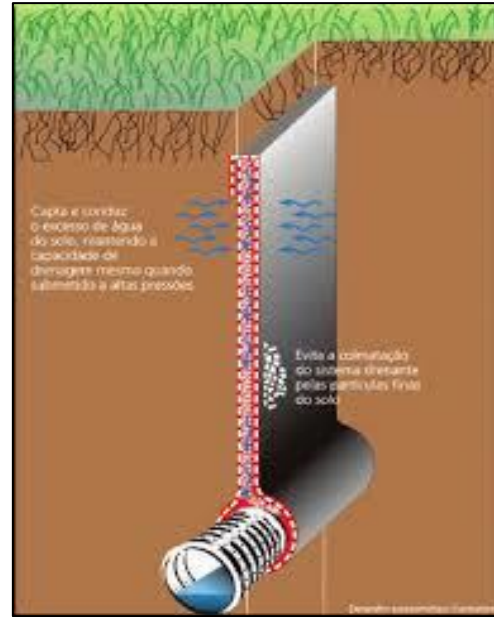
In the installation of the drainage geocomposite, simplified, it is only necessary to open the trench, position the drain and backfill for the construction of the system, following the other precautions recommended by the manufacturer. Due to the small thickness, it requires little excavation and practically eliminates the need for boot-off, minimizing the environmental impacts related to the installation of the solution.

The design of the field in question consisted of drainage lines transverse to the field, with specific spacing, and 2 longitudinal lines that would receive the flow drained by the transverse lines, also using geosynthetic materials.

Figure 9. Drainage geocomposite TD 2L.



Figure 10. Schematic drawing illustrating the TD 2L Drainage Geocomposite in a trench.



WORK METHODOLOGY

The methodology used for the development of this article involved a bibliographic survey, analysis of case studies, characterization tests of the local soil, granulometry tests and determination of the permeability coefficient of the sand used in combination with the synthetic system used in the work. In addition, the extensive content and photographic collection of the executive process of the work were consulted.

In the development of the project, it was necessary to carry out soil tests and analyses divided into two stages:

In the first stage, the drainage project was designed according to the conditions found in the field in mid-December 2007. On that date, soil tests were carried out that would serve for the preliminary design of the basic design of the subsurface layer. The permeability tests carried out on the existing soil in mid-December 2007 indicated an average permeability coefficient of 4×10^{-4} cm/s. To this end, a project was developed encompassing 20 drainage lines transverse to the field, with a spacing of 6m, and 2 longitudinal lines that would receive the flow drained in the transverse lines.

In the second stage of the project, it was necessary to consider the field conditions found at the beginning of February 2008. During this period, it was verified, *On-site*, a different compression than the one found in December 2007. For this, new permeability tests were carried out that indicated a coefficient of 3×10^{-5} cm/s. One of the hypotheses for the reduction in soil



permeability is the probable transit of heavy machinery and people and/or combined with the incidence of high rainfall, in January, on the unprotected ground of the arena.

With the new results, it was verified that the drainage project previously conceived could not technically meet the drainage needs, considering that the compaction could increase even more with the traffic of machines and people when the drainage mattress ("topsoil") was executed. In this context, the resizing of the project was proposed. Thus, with a view to improving the drainage system and meeting the importance of the work, thus starting the development of a new project, conceived and executed in the second stage.

EXECUTION OF THE DRAINAGE SYSTEM

With the results of the tests carried out in the local soil and the new project conceived, the preparation of the subsurface layer (sub-base layer) was started, with a view to having a good drainage of the water precipitated by the rain. The field was divided into two pitches with a suggested average slope of 0.5% on each side of the field, starting from the central longitudinal axis, according to the project specification.

The specific drainage project of the Bezerrão Stadium contemplated the technique in a "parallel" format, composed of ditches distributed throughout the field with all perforated for secondary drains and collectors. The drainage geocomposite of the TD 2L line was chosen because it does not have a single preferential direction for drainage, making "in a way" the same flow capacity in the longitudinal and transverse directions, allowing the installation to be carried out in a way that minimizes the work of cuts and splices, that is, there is a reduction in the amount of wasted material. The installation was done on a surface free of sharp objects, imperfections or irregularities that could minimize any damage caused to the solution conceived in the project. In order to comply with the project and to make it compatible with the executive process, the following procedures were generally followed:

- a. marking of the gauge with 20 drainage lines transverse to the field (Figure 11), spaced 6m apart, and 2 longitudinal lines that receive the drained flow in the transverse lines. The excavations were by means of a mini-excavator;
- b. Opening of the 20 collector transverse trenches with 100mm tubes. Next, the 2 receiving longitudinal trenches with 150mm tubes (Figures 12 and 13). The conduction system for the public rainwater network was executed in a diameter of 200mm;

- c. cleaning of the ditches and leveling of the trims at the bottom of these ditches by 0.5% with washed sand of \geq granulometry of 0.075mm in diameter with subsequent installation of the drainage geocomposite and drain pipe (Figures 14 and 15);
- d. filling the trenches with washed sand (Figure 16).

For the lawn, according to FIFA's recommendations, the level layer is compacted with the same 0.5% trim using a light smooth roller of approximately one ton. After this procedure, a layer of sand of 20 cm of specific granulation is placed and washed, as close to the specification of the U.S. Golf Association (USGA), above a mixture of organic material, soil and fertilizer, which will constitute the base (Topsoil) that will receive the lawn. Figure 17 shows the grassy topsoil base.

According to FIFA, a topsoil consisting of a mixture of soil, organic matter and fertilizer is recommended, with a thickness that can vary from 5cm to 10cm, considered the best base for fields, because it ensures better rooting and drainage, thus facilitating the recovery of the lawn.

Figure 11. Marking the template for the drainage lines.



Figure 12. Opening the longitudinal trenches



Figure 13. Opening the transverse trenches



Figure 14. Trenches cleaned for installation of drainage geocomposite



Figure 15. Installation of drainage geocomposite.



Figure 16. Filling the trenches with washed sand



Figure 17. Topsoil lawn
(<https://www.gardentopsoildirect.co.uk/topsoil/lawn-turfing-topsoil>, 2020).





PRESENTATION OF RESULTS

The inefficiency of the drainage of the lawn of the soccer arena of the Bezerrão stadium presented common problems and high maintenance costs. After the execution of the new drainage system, the lawn has presented excellent performance, more health and vitality to the root system of the grass, homogeneous and uniform drainage of rainwater without the presence of failures, providing more quality and playability in soccer matches throughout the drained useful area.

When it comes to the execution of the project in question, by dispensing with the hiring of specialized labor to carry out this project, it brought, in addition to excellent performance, savings.

As it is a quick installation system, the choice of the MacDrain TD 2L geocomposite as a component of this project, promoted the solution to the problems found, as important as the geocomposite, the pink sand with a diameter of 0.074 (mm) forms the appropriate "topsoil" according to the recommendations of the International Football Federation (FIFA).

The excellent results obtained by the installation of the new drainage system are noticeable at any time of the year, especially on rainy days.

In addition, in addition to all the advantages and positive results obtained by the drainage system installed in the field, there is also the importance of the technical work carried out that after the renovation, the stadium was reopened in 2008 and since then the arena has hosted professional football matches in Brasilia, in addition to major national and international competitions, such as the FIFA U-17 World Cup, in 2019. Figure 18 and 19, respectively, shows the schematic drawing of the drainage project with the proposed solution.

ACKNOWLEDGMENT

To the Centro Universitário de Brasília (CEUB) and Reforsolo Engenharia Ltda., which with important contributions made it possible to carry out this work.



REFERENCES

- ADASA. Agência Reguladora de Águas, Energia e Saneamento Básico do Distrito Federal. Mapas. Distrito Federal. Disponível em: <http://www.adasa.df.gov.br/monitoramento/mapas>. Acesso em: 04 jul. 2020.
- CELESTE, R. . Drenagem urbana: Evitando o caos I. Saneamento e Meio Ambiente. 29 maio 2013. Disponível em: <https://saneamentoambientaleagua.blogspot.com/2013/05/drenagem-urbana-evitando-o-caos-i.html>. Acesso em: 04 jul. 2020.
- CLIMATE-DATE. Clima Gama (Brasil). s.d. Disponível em: <https://pt.climate-data.org/america-do-sul/brasil/distrito-federal/gama-3305/>. Acesso em: 05 jun. 2020.
- COMPANHIA DE PLANEJAMENTO DO DISTRITO FEDERAL. Atlas do Distrito Federal. Brasília, 2017.
- CONMEBOL. Confederação Sul-Americana de Futebol. Guia Básico de Preparação de Campos de Futebol. Disponível em: <http://www.conmebol.com/sites/default/files/guia-basica-preparacion-canchas-conmebol-2019-port.pdf> . Brasília, 2019. Acesso em: 05 jun. 2020.
- DEPARTAMENTO TÉCNICO. Atividade Bidim. Aplicação do Geotêxtil Bidim do Sistema de Drenagem dos Campos de Futebol do Zico Recreio Dos Bandeirantes – RJ. Bidim: Rio de Janeiro, Mar. 1998, rev. 2011. Disponível:<http://www.bidim.com.br/public/files/cases/136545233413654523343242579193.pdf>. Acesso em: 05 jun. 2020
- FARIA, A. Estratigrafia e sistemas deposicionais do Grupo Paranoá nas áreas de Cristalina, Distrito Federal e São João D’Aliança-Alto Paraíso de Goiás. 1995. Tese (Doutorado em geologia regional) - Instituto de Geociências, Universidade de Brasília, Brasília, 1995.
- FIFA. Comitê Organizador Brasileiro Copa 2014 Recomendação Técnica para Gramados em Estádios e CTs – Rev_0. – 25 set. 2009. Disponível em: <http://infograma.com.br/wp-content/uploads/2015/10/recomendacaotecnica.pdf>. Acesso em: 06 jul. 2020.
- FREITAS-SILVA, F.H.; CAMPOS, J. E. G. Mapa Geológico do Distrito Federal em formato digital, na escala 1:100.000, Instituto de Geociências da Universidade de Brasília. Brasília: IEMA/SEMATEC/UnB, 1998.
- GAMA-DF. Administração Regional do Gama. Conheça a RA. Disponível em: <http://www.gama.df.gov.br/category/sobre-a-ra/conheca-a-ra/>. Acesso em: 07 jul. 2020.
- MACCAFERRI. MacDrain TD 2L. sd. Disponível em: <https://www.maccafferri.com/br/produtos/geocomposto-macdrain/macdrain-td/>. Acesso em: 06 jul. 2020.