Vasco Vieira da Costa, LEA, Luanda, Angola, 1965. © Margarida Quintã, 2013.

Tropical Building Research: the Angolan Case[1]

BY MARGARIDA QUINTÃ

This paper investigates how the notion of "tropical architecture" was established in Angola by looking at the local development of scientific knowledge on climate during the 20th century. It focuses on the processes that gave rise to a growing understanding of the geography and climate of the country, namely through the creation of local research institutes.
Between the 1950s and the 1970s, increasingly more climatic data was collected in the country. This data was later combined with studies in building physics, giving rise to original research developed by the LEA. Local institutions, such as the Public Works Department of Angola (DSOPA), disseminated this knowledge, eventually influencing not only the design methods of local architects but also the development of specific products in the construction sector. The LEA became a research and education organization of great relevance in Angola during the 1960s and the 1970s, as well as a symbol of modernity and the quest for scientific knowledge.

The first Western discourses on the climate of Angola emerged in the late 19th century through the records of the expeditions of Portuguese explorers – such as Brito Capelo (1841-1917), Roberto Ivens (1850-1898), and Henrique Carvalho (1843-1909) – who presented early descriptions of adverse weather conditions, putting forward various prejudices and ambiguities regarding the tropical nature of the country.[2] However, the colonialist exoticism of the first reports on the landscape and climate of Angola yielded to a more in-depth understanding of the territory in the mid-20th century. It was only in the aftermath of WWII, and particularly during the Angolan War of Independence (1961-1975), that an effective, analytical, and interpretative knowledge of the various local climates started to emerge.

Recent scholarship has often framed the architecture produced in Angola in the second half of the 20th century as "modern and tropical".[3] Yet "tropical architecture" suggests that the climate responsiveness of a building is one of the main characteristics binding a vast body of work that involves different authors, periods, and territories. Furthermore, the label "tropical", as some authors have argued,[4] suggests that this architectural legacy resulted mostly from a process of Western otherness in regard to local realities.

However, in the Angolan case, local architects and engineers often drove the progressive investigation of the country's climatic conditions. In fact, the majority of the small group of architects living in Angola in the 1960s and the 1970s shared the same concerns regarding environmental comfort and argued for an architectural practice adapted to local climates. Together with modern methods of construction resulting from new building materials and techniques, architects also demanded that building activity would take specific Angolan conditions into account.

In 1958, the architect José Pinto da Cunha (1921-1985) wrote an article in the magazine *Cultura*[5] on the housing shortage in Luanda, the city where he was based. Besides addressing his social concerns and drawing attention to the dichotomy between the formal and informal city, the architect argued that a new method for architectural practice should be invented in Angola. He stated that everything needed to be recast, starting with a different legal code and a new way of building adjusted to Angolan conditions:

> *A new technique, resulting from new materials and construction processes, must respond to a suitable body of legislation (...) that allows freedom of design and the possibility of providing the city with technically certain solutions and better architecture. (...) From ventilation and aeration, to sewage systems, to thermal insulation, to standard ceiling heights, to construction systems, etc.; everything should be re-established based on new models that could fit Luanda's tropical character.*[6]

At the time, in the late 1950s, building regulations and technical systems were mostly imported from Portugal, and knowledge of the climatic characteristics of Angola was still just beginning to be gathered. Even if the first meteorological observations had been performed at the Observatory of Luanda in 1879, it was only in 1950 that the Weather Service of Angola was established and became part of the Portuguese Meteorological Service.[7] The first comprehensive reports on the country's climatic characteristics were then published in 1955 by Fernando Leal and in 1962 by Mário Silveira.[8] It was from the climate classifications of Koppen-Geiger (1931, 1936)

and Thornthwaite (1948) that local meteorologists developed a more accurate description of the climates of Angola, dividing the country into three main areas: a tropical region in the north of the country (Aw); an arid area to the south and along the coast (Bsn); and a temperate region in the inland plateau (Cwb).

Later, in the mid-1960s, other studies provided more specific descriptions of each region based on information collected at multiple meteorological stations throughout the country. António Faria published studies on the prevailing winds in Luanda (1966) and Namibe (1969), and offered interpretations for temperature reports in Luanda, Lobito, and Dundo (1963).[9] Studies on solar radiation and solar charts were also developed for the first time during this period.[10]

These meteorological studies on Angola's sub-climates allowed, at a later stage, for the interpretation of this specific knowledge to be disseminated throughout the construction sector by the LEA. In a paper presented in Kenya in 1959, Frederico Colaço[11] pointed out that the laboratory, at that time, was only dealing with the problems of roads, soil mechanics, and building materials. Simultaneously, he argued that the LEA ought to develop a section for the study of building physics right away, in order to focus on issues of thermal comfort, air conditioning, and lighting, as a result of what he called "practical developments of applied climatology". In his view, the laboratory should use the climate data collected by the Angolan Meteorological Service (SMA) to develop scientific studies and form an analytical approach to climate management in the country. Furthermore, he even suggested,

> *The modern scientific trend dictates that the problems concerning the discipline of architecture need to be addressed together with the purely scientific and technical ones.*[12]

Hence, in his view, climatology, building physics, and architecture should join together within a new field of research at the Angolan laboratory.

Vasco Vieira da Costa and the LEA

The origins of the LEA date back to 1946, when a material testing laboratory was established in Luanda as a section of the Public Works Department. At that time, the Angolan laboratory's only assignment was to collect soil samples from all regions as part of a countrywide soil survey, and to send this information to the National Civil Engineering Laboratory (LNEC) in Lisbon.

However, ten years later, the volume of construction work per year in Luanda had tripled.[13] As the public laboratory was the only organization equipped to carry out geotechnical investigations, it also began to provide services to private entities. As a result of this lucrative funding system, the institution became more ambitious; expanded its staff, hiring the first two engineers in 1955; and began sponsoring research, enriching its library, and providing technical training to high-school students. From 1955 to 1961, the laboratory underwent a period of exceptional growth that was mainly driven by road and dam construction, reaching 200 employees in 1961.

In 1961, at the beginning of the Angolan War of Independence, the LEA finally became an autonomous research institute, and the architectural project for its permanent facilities commenced. Vasco Vieira da Costa was then hired by the laboratory not only to design the new building but also to bring architectural topics into the research unit, finally realizing the aspirations that Frederico Colaço had put forward two years earlier.

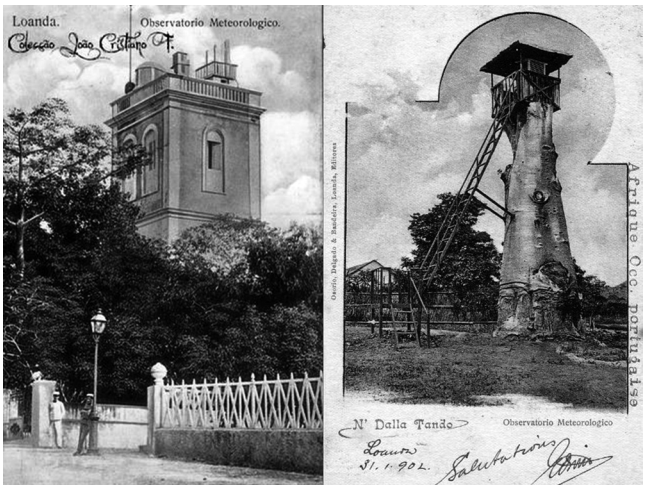
Vasco Vieira da Costa had recently resigned his position as a consultant architect for Luanda's town council (1949-1959), shortly after completing his first project, the grandiose Quinaxixe Market (1950-1958) in Luanda's downtown. Even though he lived in Luanda most of his early life, he left Angola to study architecture in Porto (College of Fine Arts of Porto, ESBAP, 1940-1949) and urbanism in Paris (University of Paris, 1946-1948). During the years he lived in Paris, he was part of the founding group of the ATBAT, *Atelier des Bâtisseurs*, an interdisciplinary team organized by Le Corbusier in 1947 for the Marseille Unité d'Habitation commission. In 1949, he finished his degree in Porto with a master plan for a satellite-city on the outskirts of Luanda as his graduation project,[14] and then moved back to Angola the same year.

At that time, the design limitations imposed by climate were already at the top of Vasco Vieira da Costa's concerns, and so he carefully examined Luanda's weather data in order to inform his urban planning and architectural design. Therefore, the LEA project was no exception. In the project description, Vasco Vieira da Costa wrote about the "captivating but challenging task" of developing a building adapted to such "specific functions as observing, studying, discovering, creating, and controlling."[15] He quoted Pierre Chevenard (1888-1946), who had described the ideal scientific workplace as aseptic, methodical, and calm. Consequently, environmental comfort was a major concern of the project due to its influence on productivity and efficiency. The natural constraints of the site were carefully considered and "the architectural design essentially became the consequence of the local climate."[16] The hot and humid climate of Luanda was controlled solely by passive methods, such as the building's orientation, natural ventilation, and sun shading. Hence, the architectural form resulted from the combination of these features, and was described by the architect as a purely scientific result.

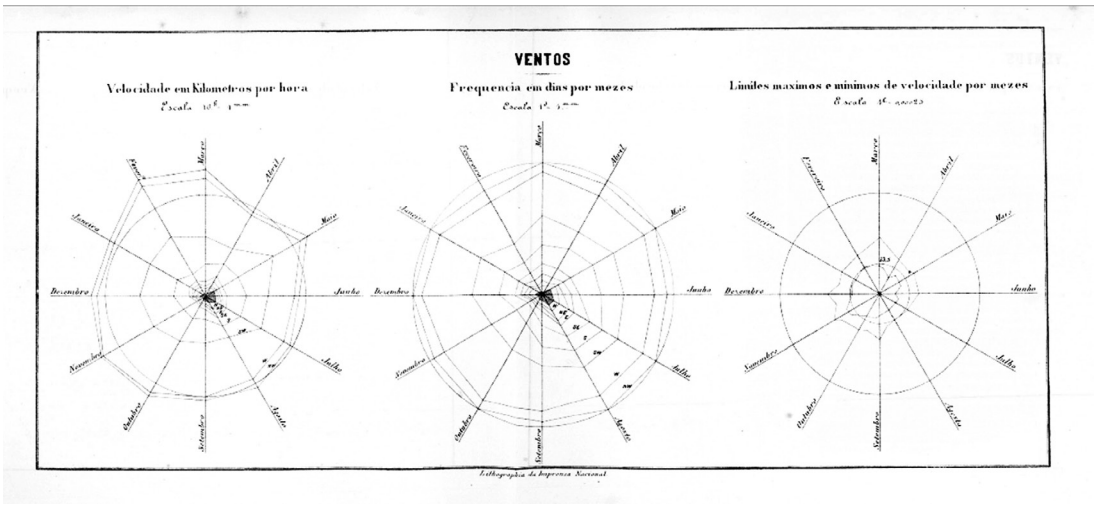
Vasco Vieira da Costa stated: "A laboratory is, indisputably, the most typical functional building, so it must be (...) a precise and effective tool." Furthermore, he claimed that the architectural design of a laboratory should be "alien to monumental or ornamental concerns" because the "the nature of a laboratory determines such strong constraints that (...) necessarily lead the architect to pure expressions." Therefore, the architectural solution epitomized "sobriety and accuracy (...), which are the attributes of the useful and the scientific."[17]

Reading the architect's texts, we may therefore conclude that he intended that this building would somehow

01 Postcards of meteorological observatories in Luanda and N'dalatando, Angola, 1902.

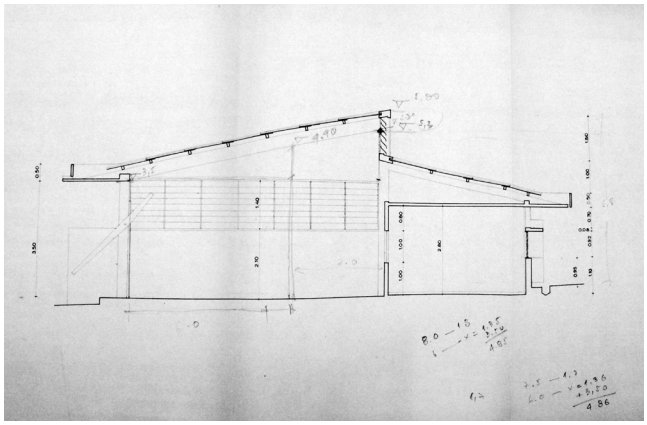


02 Vasco Vieira da Costa, LEA, Luanda, Angola, 1968, aerial view. © LEA archive.



03 Wind charts, Luanda, Angola, 1892. © Henrique Carvalho, *Expedição Portugueza ao Muatiânvua – Metereologia, Climatologia e Colonização: método práctico de fazer colonisar com vantagem as terras de Angola*, Lisboa, Typographia do Jornal *As Colónias Portuguezas*, 1892.

04 Vasco Vieira da Costa, LEA, Luanda, Angola, 1965, pivot doors as shading system. © LEA archive.



05 Vasco Vieira da Costa, LEA, Luanda, Angola, 1963, pavilion A, section. © LEA archive.

represent the doctrine of the institution, in its theoretical and formal aspects: accurate, scientific, sober, and rigorous. At the same time, and perhaps more importantly, the building should also adapt to local constraints, and its climate responsiveness should be taken as an essential condition of its functioning.

Yet, that same year, the LEA bought a property near the airport and Vasco Vieira da Costa was forced to develop a new project to fit rather different circumstances. The plot was located in a peripheral area of the city and was much larger than the first, which led to an entirely different organization of the plan. In the first solution, a set of pavilions was oriented in an east-west direction which, according to the architect, was the ideal orientation "confirmed by theory and experience." He stated that

> *in hot and humid climates like Luanda, the correct orientation of buildings is one of the factors that can surely contribute to diminishing the feeling of discomfort caused by high temperatures combined with high levels of humidity.*[18]

At the site near the airport, a different building orientation was necessary to adjust to the contrasting plot configuration, and the limited budget determined that the buildings could not have artificial systems for environmental control. As a result, instead of designing calm, methodical, and controlled environments, the architect conceived laboratories that were completely open to the outside weather. Thus, despite Vasco Vieira da Costa's cultured understanding of modern science as aseptic and sterile, he had developed an architectural solution that was quite permeable and adapted to local circumstances. This choice was, however, an absolutely rational decision and consistent with his pragmatic approach.

In 1963, the first three pavilions – A, B, and C – were built. Each was destined to house one of the main sub-sections of the LEA: geotechnical engineering, roads and aerodromes, and structures and buildings. The identical pavilions are parallel to the dominant axis, 30 meters apart, and located at the north end of the site:

> *Its positioning depended mainly on the judicious study of cross-sections, where an attempt was made, by simple and economic means, to alleviate the inconveniences resulting from the incorrect orientation to which the topography of the plot led.*[19]

Looking at the building's section, one can easily understand that the smaller offices were placed along the east facade, while a large double-height open-plan space was on the west. Consequently, this large room takes advantage of the prevailing southwest winds, and works as a cooling system for the whole building. Moreover, the openings on the west facade are covered with large pivot doors that are manually operated and open horizontally to create a shadowed area.

In the years that followed, the building campaign continued. A new set of blocks – D, E, F, G – was built to house more offices and stockrooms in 1965, and the pavilions of the Faculty of Civil Engineering (J, L, M, O) were inaugurated in 1966. Civil Engineering had been one of the first degrees offered in Angola, beginning in 1962,[20] despite the great shortage of teaching staff in the country. For this reason, the LEA collaborated with the University of Luanda from the beginning, and classes were held at the LEA premises from 1966 onwards. University students were hired as part-time employees, which established a direct link between teaching and practice. Henrique Novais Ferreira, the director of the LEA, stated in 1967 that the students were being "trained at an excellent technical level and prepared for the reality of the country, in its social and physical aspects."[21] In the academic year 1969/1970, the first eight engineers graduated from the University of Luanda, and in the years that followed, several new graduates joined the faculty, making up for the lack of technical staff.

The LEA facilities were still expanding in 1975 when the Angolan Civil War (1975-2002) broke out after the country's independence. As a result, the largest building in the complex, 120 meters long and three floors high, destined for administrative functions and the library, was never fully completed. Likewise, the hydraulic pavilion project, developed by Vasco Vieira da Costa in 1969, was never built.[22]

Building research

At the same time that the LEA facilities were being developed, the results of engineering research were also being disseminated via publications that percolated through the colonial society of Angola. Between 1957 and 1974, the LEA published many original papers and also released translations of technical information from other languages. Throughout this time, the papers focused on the most pressing subjects concerning the country's development, starting with geotechnical studies in the late 1950s and then focusing mostly on issues related to building physics in the 1970s. At the same time that these topics expanded, architecture progressively assumed greater prominence, not only in the publications, but also at the conferences in which the laboratory took part in Angola (1957, 1969), Portugal (1965), Mozambique (1965, 1971), and Brazil (1967).[23]

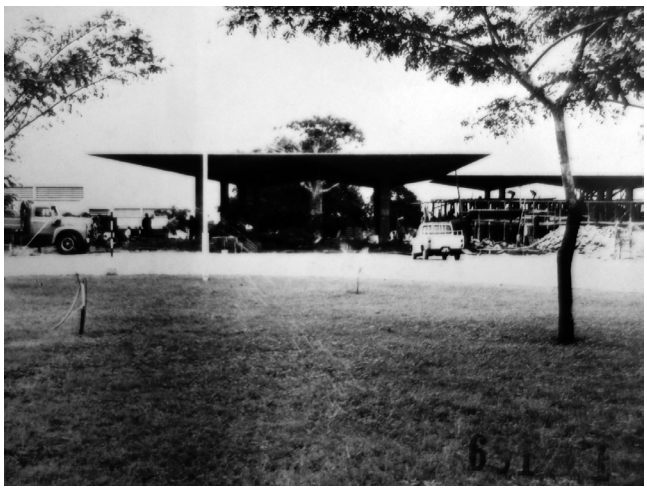
Yet the first wide-ranging article concerning climate and building design in Angola would only be released in 1965. Henrique Novais Ferreira, a civil engineer who had been the director of the LEA since 1955, authored the paper, "Thermal environment concept applied to the design of dwellings." For the first time, weather data from the various Angolan sub-climates was presented and examined, along with a discussion of thermal comfort and its desirable influence on architectural design. The article was released in Luanda by the LEA and also in Lisbon by the national magazine *Fomento*, which disseminated scientific contributions to economic and technical development from the Portuguese colonies.[24]

The paper had actually been written in 1963 and was the result of the LEA's cooperation with the SMA, which provided the weather data and supported the climatic classifications presented in the article. The cooperation between the two local institutions had already been established in other previous studies, namely on wind reports and on the rainfall regime of Luanda, which occasionally caused

06 Vasco Vieira da Costa, LEA, Luanda, Angola, 1968, pavilion A, double-height open-plan space. © LEA archive.

07 Vasco Vieira da Costa, LEA, Luanda, Angola, 1965, pavilions D, E, F, G. © LEA archive.

08 Vasco Vieira da Costa, LEA, Luanda, Angola, 1965, campus. © LEA archive.



09 Vasco Vieira da Costa, LEA, Luanda, Angola, 1965, materials pavilion. © LEA archive.

landslides resulting in great damage to roads and buildings.[25]

From 1965 onwards, bioclimatic design was a topic of concern to the LEA with the publication of several foreign studies on the subject. Selected contributions from the United Nations' Housing and Town and Country Planning, the RILEM, and the South African National Building Research Institute were translated and issued in the LEA's monthly bulletins.[26] However, the only broad study focusing on Angolan conditions and offering practical solutions was the one developed by Henrique Novais Ferreira. His long scientific article aimed both at providing an academic reading of the topic and a handbook for architectural practitioners in the country.

Henrique Novais Ferreira considered that "knowledge of local climatic conditions was the first step in defining, on a scientific basis, the conditioning requirements for the construction of residential buildings."[27] As engineering research was an exclusive preserve of the laboratory, he stressed that defining the essential technical knowledge applicable in Angola in the fields of structures, building materials, building systems, building physics, and also bioclimatology was the task of the LEA.

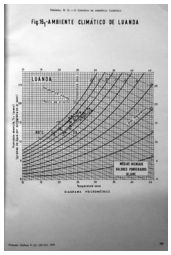
A table with the volume of construction work in the country started the article: an average of 200,000 m²/year had been built during the last ten years, and there was a common belief that the number would rise in the years that followed. Henrique Novais Ferreira therefore advocated the need to develop a specific knowledge of the local construction industry:

> *The construction of residential buildings follows very naturally the local and regional experience, but is also influenced by fads from all territories, including those of temperate and cold climates. Housing standards are based to a large extent on studies and technical work carried out in Europe and North America, and for their climates and regions. And some of these regulations are not suited to tropical climates. Architectural trends, regulations, building habits, and even developments that ignore the site, may result in useless expenses and solutions compromising the comfort of housing.*[28]

Despite this consideration, the author resorts mainly to European authors and cites technical studies by Stone (1941), Blanc (1952), Dreyfus (1960), and Missenard (1960) on the evaluation of thermo-hygrometric parameters and environmental comfort. He also mentions authors such as Raymond Ayoub (1960), David Oakley (1961), and the Portuguese Gomes (1962) to defend the necessity and relevance of the thermo-hygrometric study method for the design of buildings in different regions of the world. Finally, Griffith Taylor's climograph, designed for Australia in 1916, serves as a guide for the psychrometric charts presented by Henrique Novais Ferreira for each of the Angolan sub-climates.

Henrique Novais Ferreira labelled three eco-climatic types in Angola: the dry iso-hygrometric, the isothermal, and the humid iso-hygrometric. In addition to presenting psychrometric diagrams for different cities in the country,

10 Psychrometric chart of Luanda, 1965. © Henrique Novais Ferreira, *O conceito de ambiência climática aplicável aos estudos de edifícios para habitação*, Memória LEA, No.101, Luanda, LEA, 1965.



he proposed an analytical method for climate-responsive architectural design. Hence, he put forward a graphic table that, when overlaid with the psychrometric diagram of a given place, displays architectural design requirements, such as those for direct or indirect ventilation, thermal inertia, insolation, and air conditioning.

Unsurprisingly, this report became influential for architectural practice in Angola in the years that followed. Although the document did not provide specific design guidelines, the recommendations were detailed enough to determine the exact needs for shading and natural ventilation in each region. Since this study was published both in Angola and in Portugal, its reach was broad in the community of architects developing projects for Angola at that time.

Climatological data was passed on to architects by the Public Works Department and by municipalities.[29] The climographs of Angolan cities were often used in project descriptions, and even served as evidence in various disputes between architects and institutions.[30] However, as this information was only made available in 1965, it seems fair to think that prior to that time, local architects had already developed an empirical understanding of Angolan climatic conditions, as well as of passive environmental control systems.

Even though the literature produced by the LEA remains largely unexplored to this day, Henrique Novais Ferreira's article was contemporary to some of the most groundbreaking books on climate-responsive design methods in tropical regions, including Maxwell Fry and Jane Drew's *Tropical Architecture in the Dry and Humid Zones* (1964) and *Design with Climate: Bioclimatic Approach to Architectural Regionalism* by the Olgyay brothers (1963). Henrique Novais Ferreira's article was also representative of the laboratory's quest for scientific knowledge on the climate of Angola in order to establish the basis of an analytical approach to architectural design methods in the mid-1960s. This increasing knowledge of different Angolan geographical environments enabled architects, institutions, brands, and all other sorts of agents to master climatic data, and its integration into architectural design.[31] In so doing, the LEA allowed the modern architecture of Angola to become more responsive and less theoretical, more precise and less generic.

Notes

1 This text is an abbreviated version of the chapter "Design with climate in Angola" from: Margarida Quintã, *Modern Schools in Angola, 1961-1975: Design with Climate and Heritage*, Thesis (PhD), École Polytechnique

Fédérale de Lausanne/Instituto Superior Técnico, Universidade de Lisboa, 2019.

2 Hermenegildo Brito Capelo, Roberto Ivens, *De Angola à contra-costa*, Lisboa, Imprensa Nacional, 1886; Henrique Carvalho, *Expedição Portugueza ao Muatiânvua – Metereologia, Climatologia e Colonização: método práctico de fazer colonisar com vantagem as terras de Angola*, Lisboa, Typographia do Jornal *As Colónias Portuguezas*, 1892.

3 See, for instance: Ana Tostões (ed.), *Modern Architecture in Africa: Angola and Mozambique*, Lisbon, ICIST/Técnico, 2013.

4 On this subject: David Arnold, *The Problem of Nature: Environment, Culture and European Expansion*, Oxford, Blackwell Publishers, 1995.

5 The Magazine *Cultura* was published by the Cultural Society of Angola between 1957 and 1960. This cultural institution was established in Luanda in 1942 and extinguished by the Portuguese security agency PIDE/DGS in 1966.

6 Free translation: José Pinto da Cunha in "O problema da habitação em Luanda. É preciso construir casas para todos...", *Cultura*, No. 2 and 3, Year 1, Luanda, January/March 1958, 12.

7 Presidência da República Portuguesa, *Instituição de Serviços Meteorológicos nas Colónias,* Lei 2042, 17 June 1950.

8 Fernando Leal (coord.), *O Clima de Angola*, Luanda, Serviço Metereológico de Angola, 1955; Mário Silveira, *Climas de Angola*, Luanda, Serviço Meteorológico de Angola, 1962.

9 António Faria, *Temperaturas equivalentes de Luanda, Lobito e Dundo com vista ao estudo de habitações*, Memória LEA 99, Luanda, LEA, 1963; António Faria, *Direcção e intensidade média dos ventos predominantes em Luanda*, Memória LEA 115, Luanda, LEA, 1966; António Faria, *Direcção e intensidade média dos ventos predominantes em Moçamedes*, Memória LEA 152, Luanda, LEA, 1969.

10 Alexandre Gama Vieira, *A radiação solar sobre planos verticais orientados em Luanda*, Serviço Meteorológico de Angola, in Boletim Informativo 2 (14), Luanda, LEA, 1964; Armando Cavaleiro Silva, João José Malato, *Geometria da Insolação de Edifícios*, Lisboa, LNEC, 1969.

11 Frederico Colaço was an engineer and the director of the Section of Buildings and National Monuments of the Public Works Department of Angola.

12 Frederico Colaço, *Melhoramentos de habitação tradicional em Angola,* Memória, LEA, No. 52, Luanda, LEA, 1959. Lecture presented at the Inter-African Conference of Town-planning and Housing – CCTA/CSA held in Nairobi, Kenya, 19-30 January 1959.

13 See the table: "Civil Construction in Luanda", from: Henrique Novais Ferreira, *Evolução demográfica de Luanda - subsídios para a sua urbanização,* Memória LEA, No. 59, Luanda, LEA, 1959, 174.

14 Vasco Vieira da Costa, *Cidade Satélite nº3 Concurso para a obtenção do diploma de arquitecto 1948*, Porto, ESBAP, 1984.

15 Free translation: Vasco Vieira da Costa, "Instalações do Laboratório de Engenharia da DSOPA", Luanda, Fevereiro 1960.

16 Free translation: Idem, 1.

17 Free translation: Idem, 2.

18 Free translation: Idem, 3.

19 Vasco Vieira Da Costa, "Instalações definitivas do Laboratório de Engenharia de Angola - memória descritiva dos pavilhões A, B e C", Luanda, Abril 1963, 1.

20 Ministério Do Ultramar, *Criação dos Estudos Gerais Universitários em Angola e Moçambique,* Decreto-lei 44530, 21 August 1962.

21 Free translation: "Engenheiros formados com excelente nível técnico e sensibilizados para as realidades do país, quer de natureza social, quer de especificidades naturais" in Henrique Novais Ferreira, *Os tipos de investigação e a actividade dos Laboratórios de Engenharia*, Memória LEA, No. 125, Luanda, LEA, 1967, 4.

22 Vasco Vieira Da Costa, "Memória descritiva do Pavilhão de Hidráulica", Luanda, Setembro 1969.

23 *Jornadas Luso-Brasileiras de Engenharia Civil*, Lisbon, 1965, Rio de Janeiro, 1967, Lourenço Marques, 1971; *Primeiras Jornadas de Engenharia de Moçambique*, Lourenço Marques, 1965; *Segundas Jornadas de Engenharia e Arquitectura do Ultramar*, Luanda, 1969.

24 Henrique Novais Ferreira, *O conceito de ambiência climática aplicável aos estudos de edifícios para habitação*, Memória LEA, No. 101, Luanda, LEA, 1965; Henrique Novais Ferreira, "O conceito de ambiência climática aplicável aos estudos de edifícios para habitação", *Fomento - Técnica e Economia Ultramarinas*, Lisboa, Vol. 3, No. 2, Second Quarter, 1965, 145-222.

25 Henrique Novais Ferreira, *Avaliação de caudais pluviais*, Memória LEA, No. 48, Luanda, LEA, 1959; Henrique Novais Ferreira, *Precipitações pluviométricas excepcionais em Luanda*, Memória LEA, No. 53, Luanda, LEA, 1959; Henrique Novais Ferreira, *O método dos valores extremos no cálculo de chuvadas excepcionais em Luanda*, Memória LEA, No. 54, Luanda, LEA, 1959.

26 See, for instance, J. F. Van Straaten, *A construção nos climas quentes*, National Building Research Institute (South Africa), DT 99, Luanda, LEA, 1966; E. N. Van Deventer, J. F. Van Straaten, *Uma base racional para determinar dados climáticos para utilização nos projectos de edifícios*, National Building Research Institute (South Africa), DT 106, Luanda, LEA, 1966; RILEM, *O comportamento e durabilidade dos materiais de construção em climas quentes*, Réunion Internationale des Laboratoires et Experts des Matériaux, Boletim Informativo 3 (28), April 1965, DT 66, Luanda, LEA, 1965; Adrian Atkinson, *A habitação nos trópicos*, Housing and Town and Country Planning, United Nations, Bulletin 6, DT 62, Luanda, LEA, 1965.

27 Free translation: Henrique Novais Ferreira, "O conceito de ambiência climática aplicável aos estudos de edifícios para habitação", *Fomento – Técnica e Economia Ultramarinas*, Lisboa, Vol. 3, No. 2, Second Quarter, 1965, 146.

28 Ibidem.

29 See, for instance: Escola Comercial e Industrial do Lobito, Jorge Moreira, 1967-1970 (AHN/Fundo Obras Públicas/Benguela/Ministério da Educação/17.3.1). "Chamamos a atenção para a importância que no local reveste a percentagem dos ventos dominantes diurnos. Os do sul são nocturnos. Há que atender à humidade relativa diária que é praticamente constante e de 80 %." in "Condicionamentos urbanísticos", Câmara Municipal do Lobito, 26 May 1962.

30 E. g., Francisco Castro Rodrigues sent Lobito's climograph to the Education Department in 1967 in a dispute concerning the Lobito's lyceum works.

31 Namely the Public Works Department and the LEA, but also advertisements by Lupral and articles by Campina, Bernardes, Cunha, Rodrigues, etc.

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