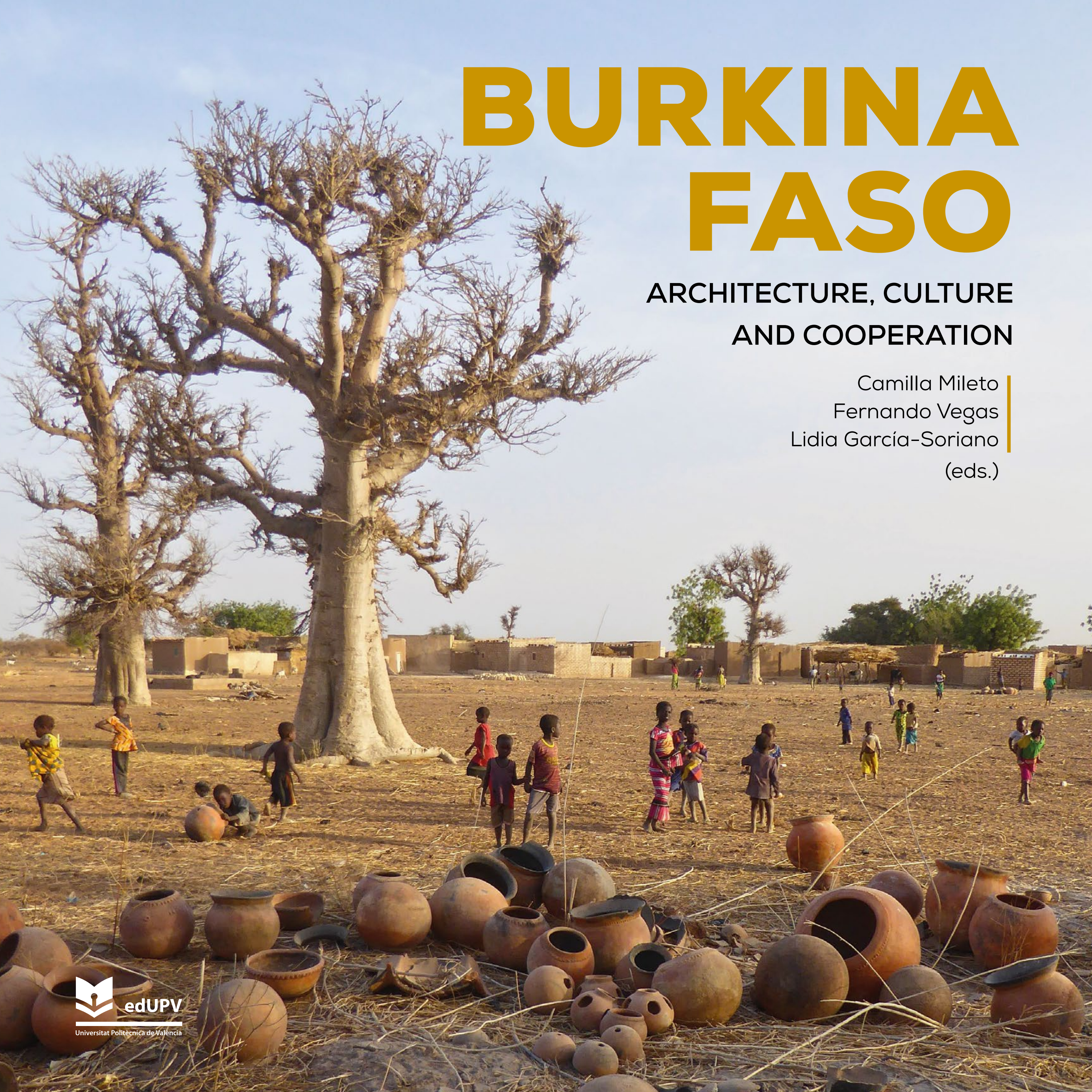

BURKINA FASO

ARCHITECTURE, CULTURE AND COOPERATION

Camilla Mileto
Fernando Vegas
Lidia García-Soriano
(eds.)

edUPV
Universitat Politècnica de València

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Editors

Camilla Mileto, Fernando Vegas, Lidia García-Soriano

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Editors

Camilla Mileto holds a PhD in Architecture and is a professor at the Universitat Politècnica de València. As well as being a guest lecturer and giving lectures in several universities, she has received international awards for her work. She has developed conservation projects for the Alhambra of Granada and Gaudí's Finca Güell in Barcelona, among others. She is co-editor of the journal Loggia and has published extensively on architectural heritage.

Fernando Vegas López-Manzanares holds a PhD in Architecture by the Universitat Politècnica de València, where he is a professor of undergraduate and master's courses. He has been guest lecturer in Argentina, Italy and United States and has delivered lectures in various institutions and universities in several countries. He is co-editor and founder of the journal Loggia and has extensively published books and articles on architectural heritage.

Lidia García-Soriano holds a PhD in Architecture and is a professor at the Universitat Politècnica de València. Her professional and research activity focuses on architectural heritage in general and earth-en architecture and traditional construction techniques in particular, as well as on the study of conseration criteria and techniques. She is a member of ICOMOS Spain, ICOMOS-ISCEAH and the Ibero-American network PROTERRA.

Abstract

This book aims to pay homage to the people, culture and traditional architecture of Burkina Faso, a country with an extraordinary wealth of construction cultures. Through cross-referencing and analysis this book provides an overview of the architectures of the Birifor, Bobo, Dogon, Gan, Kassena, Ko, Lela, Lobi, Mossi, Nuna, Peul, Puguli, Senufo and Tuareg, offering a series of interpretations. It examines habitat, construction materials, elements, space and notions underlying their vernacular architecture, types of buildings and built heritage as well as the weaknesses of their state of conservation and maintenance. It also presents a reflection on the concept and history of cooperation architecture in the country as a preamble to the description of the development cooperation project carried out by the Universitat Politècnica de València in the village of Baasneere.

Dedicated to the memory of Juanvi Maravilla
(1964-2020)

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Introduction

In March 2014, the members of the RES-Arquitectura research group at Universitat Politècnica de València organized the course "Earthen architecture: constructive technique and restoration". This was the first in a series of courses and workshops we ran in the framework of the "UNESCO UNITWIN Chair of Earthen Architecture, Building Cultures and Sustainable Development" until the 2020 pandemic put a stop to these. The courses, dedicated to traditional materials and techniques (earth, lime, gypsum, reeds, rammed earth, adobe, CEBs, rendering, tile vaults, etc.) highlighted these vernacular constructive processes, stressing their value as constructive traditions and also promoting their use in the conservation actions of historic buildings or in the construction of contemporary architecture seeking a higher level of environmental, sociocultural and socioeconomic sustainability. The architect Juan Vicente Maravilla – one of the driving forces of Algemesí Solidari together with Xavier Ferragut – took part as a student in the workshop on earthen architecture held in March 2014. From that point, Juanvi took us on an intense adventure which has lasted until today, with the publication of this book. Juanvi, a permanent source of boundless energy until illness led to his death, would have been immensely proud of this.

Since 2009, the Algemesí Solidari association has been collaborating on a series of aspects, including social, medical and infrastructural issues, with the local association A3B in Baasneere (Burkina Faso), a village twinned with Algemesí in Valencia. Against this backdrop of cooperation, in 2014 talks were ongoing regarding the construction of a secondary school in Baasneere. As there was no such infrastructure the younger population had to cover many kilometres on foot to the nearest secondary school. This then meant that access to secondary education was limited to very few students among the local population. Algemesí Solidari proposed a construction that was as environmentally, socially and financially sustainable as possible. To achieve this, Juan Vicente Maravilla, the architect in charge of the design of the school, proposed to use earth as a constructive material and attended the workshop we organized in order to learn more about these techniques. The project for the school as part of the activity of the Algemesí Solidari association can be found in the chapter "Algemesí Solidari and l'Escola de Baasneere" in this book.

From then on we began a permanent collaboration which led to the setting up of different training workshops: for students and others taking part in the design of the school (July 2014); on tile vaults as techniques for the construction of the school roof (February 2015); and on the CEB technique chosen for the construction of the school (June 2015). Our research group also helped draw up the project from its earliest stages and throughout the later stages. Meantime, the UPV Centre for Development Cooperation awarded us a grant for the "Standing With Burkina" project (2016-2018) as part of the UPV's "ADSIDEO Programme – Cooperation 2016". This funding allowed us to set up the framework for our involvement in the project, following three work axes: a research plan providing scientific support for the construction of the school in the materials (choice of earth) and constructive details (production, execution, feasibility and implementation of CEBs in tile vaults); a technical training plan for the local workers in charge of the construction of the school; and a plan to raise awareness of earthen architecture and its environmental and cultural benefits among the local population, especially the children and future users of the building.

Throughout this cooperation project we carried out scientific research at the UPV on the materials to be used, dosage, resistance, vault design, structural calculations, etc..., providing scientific and technical support in the design and construction of the school. This research is detailed in the chapters "Research and scientific and training support for a cooperation initiative", "Earthen tile vaults. Geometric optimization and structural behaviour" and "Earthen tile vaults. Experimentation and constructive process". Moreover, from the early stages of the project we discussed possible training and awareness activities to be carried out in Baasneere, in keeping with the desired goals: professional training workshops for builders and developers from the country's capital, Ouagadougou and from the village of Baasneere (an experience recorded in the chapter "Construction workshops for the professional training and technical empowerment of the community"); and workshops for raising awareness among the children of the primary school of Baasneere (activities explained in the book chapter "Awareness workshops"). These activities were designed specifically for our stay in Baasneere in January 2018.

During this stay in Burkina Faso, we also began complementary and parallel research to ensure a better understanding of the setting we were working in. The first objective was to learn more about the traditional architecture of the village of Baasneere and its conservation and transformation issues, as well as the culture which these constructions were based on; secondly, we tried to expand our gaze towards the country's traditional architecture in order to identify the role of the Mossi architecture of Baasneere within the constructive cultures of Burkina Faso; and thirdly, we aimed to learn about types of architecture which were being promoted through international cooperation, especially cases which sought to establish a relationship with local constructive culture. This research, initiated in situ with visits and interviews and later expanded, is recorded in the first part of the book in the chapters "The architecture of Burkina Faso" and "Cooperation architecture".

Following a grant from the Cooperation Programme, awarded by the Centre for Development Cooperation of the Universitat Politècnica de València in the 2017-2018 academic year, in September and October 2018, María Lidón de Miguel, then a student of the Master's in Conservation of Architectural Heritage at the Universitat Politècnica de València, after an extended stay in Burkina Faso, was able to provide us with further information. This was based on the urbanism, architecture and traditional construction in Baasneere, research which she used to complete her End-of-Master's Project "Baasneere (Burkina Faso): Urban, Typological and Constructive Study", 2019. Part of this features in the chapters "The village of Baasneere", "Urbanism and architecture in Baasneere" and "Housing in Baasneere".

In situ work was interrupted in 2019 and came to a halt, first due to the political situation in the country and later the health emergency which arose in 2020. However, the school in Baasneere is still being built in phases and the research group continues to collaborate with Algemesí Solidari in the design of the different parts of the complex. Without a doubt, this cooperation project contributed to the school in Baasneere with its scientific and technical support. Its training and awareness actions aim to increase understanding of and appreciation for the architecture being built while searching for an architecture which is more committed to its environmental and social surroundings. However, the aspects which are not necessarily linked to the outcome of the architectural project are equally important. These include the mutual learning process observed throughout and the importance of local residents identifying with architecture. The school is not finished and construction will continue over the next few years but the collaboration carried out until now has resulted in a joint learning process, an understanding of cultural diversity, mutual respect and a recognition of the value of differences.

The results of the cooperation project can be found on its webpage[1]; in an exhibition which was the subject of different displays and can be consulted online on the project webpage[2]; in conferences and seminars; and in different papers and publications from international conferences. These results have been finally compiled in this book which aims to provide information on the research, project, collaboration and activities carried out, showing what was learnt during this experience as well as the scientific results.

[1] https://conburkina.blogs.upv.es/

[2] https://conburkina.blogs.upv.es/exposicion/

PART 1. BURKINA FASO

This part aims to help understand the historical and geographical context of Burkina Faso and the concept of cooperation architecture. Burkina Faso, an inland country with a millenary culture, is located in central West Africa. With borders that were artificially established by non-African agents as recently as 1908, Burkina Faso remained a French colony until 1960, when it gained its Independence as a country named Upper Volta. At least 26 ethnicities, ten languages and several religions coexist in this country. For this reason, in 1984 President Thomas Sankara coined the new name Burkina Faso and the adjective Burkinabè, referring to three main languages spoken in the country.

As with its geographical limits and organizational structure, colonial architecture was initially the dominant choice, despite its lack of sustainability and cultural, bioclimatic and material unsuitability. However, in the 1970s initial steps were taken to explore an architectural language more in keeping with the culture of the country. The 21st century saw the advent of a new concept both in Burkina Faso and other developing countries: cooperation architecture – new projects with foreign funding that aimed to co-design local architecture with the residents, making at least partial use of vernacular culture, materials and local techniques. The second chapter explores this new architectural concept, both in Africa and Burkina Faso, as well as its main internationally recognized representatives, including Pritzker Prize winner Diébedo Francis Kéré.

Loumbila Dam on the Massili river, tributary of the Nakambe or White Volta.

1. Historic and geographical context

An international cooperation project proposed for a country which was unknown at the outset had to be based on the most in-depth study possible of the country and its constructive traditions. Equally, research on vernacular architecture is linked both to the understanding of the cultural context of the society which built it (history, way of life and customs) and to the physical context which made it possible, the geographical and climate conditioning factors which also provide natural resources and the optimum way to use them.

Some of the key aspects for an understanding of the characteristics of the traditional architecture of Burkina Faso at present are the situation of a territory inhabited by a wide range of cultural groups, how the territory was outlined to become an independent state, the historical evolution which led to the current situation of the country. It was also subject to influences from the Sahara and the Atlantic given its continental location.

Historical evolution of the territory before becoming a country

Burkina Faso is located in the centre of West Africa, surrounded by Mali to the northwest; Niger to the east; and Benin, Togo, Ghana and Ivory Coast to the south. However, it should be borne in mind that these territories were only recognized as states just over a century ago and that their borders are based on outlines set mostly by non-African agents. One example is the straight line of a parallel dividing the new colonies of Ghana and the Upper Volta (now Burkina Faso) established in an agreement signed in Paris in 1898.[3]

In the late 19th century, Upper Volta was the territory situated on the upper basin of this river, fed by its tributaries *Nakambe* (White Volta), *Nazinon* (Red Volta) and *Mouhoun* (Black Volta). This territory was home to numerous cultures which shared features in language structure, social organization systems, politics, and religious beliefs. All of these had unique characteristics which shaped their identity as different cultural

[3] Joseph Ki-Zerbo, *Historia del África Negra: De los orígenes a las independencias* (Barcelona: Edicions Bellaterra, 2011): 609.

groups. These similarities and unique features could be seen in their construction: physical proximity meant that the natural resources available and the demands of climate were similar, although the culture of each individual society brought its own distinctive features to the use of materials.

The arrival of Europeans brought with it an interest in learning more about these peoples. Initial attempts made to classify these "Voltaic peoples" by language led to extensive academic debate due to the lack of consensus on classification criteria for the variants of local languages into groups and subgroups.

In addition, a risk was entailed in passing from a classification by language to a classification by culture, as the linguistic and cultural spheres did not necessarily overlap. According to Izard, this could lead to cultures being grouped under the same name which when examined in depth would have shown original aspects that would have led them to be considered independent from each other.[4]

Based on this debate and subsequent research, historian Joseph Ki-Zerbo listed four different population groups:[5] The autochthonous peoples (Gurunsi, Senufo, Dongo, Bwa, Kurumba, etc.); peoples with a Mande culture (Bissa, Samo, Bobo-fing, Yarsé, etc.); the Fula or Peul, a semi-sedentary people; the Mossi.

Throughout history out of these groups only the Mossi appeared to have created a recognizable state based on grouping kingdoms (Yatenga, Ouagadougou, Koudougou, Tenkodogo and Kaya) which demonstrated their authority over the rest of peoples. However, as the author points out, this statement is relative as the scope of local authority and the complexity of the political relationships between groups were not known.[6]

In short, the Volta territory was mostly occupied by the Mossi who inhabited the basin between the *Nakambe* and *Nazinon*. Other peoples in the area were the Peul and Gourmantche in the north and east; the Bisa and Gurunsi in the south; the Lela, Ko, and Samo in the west; and the Lobi, Bobo and Birifor in the far south.[7] These groups would have settled in the territory as a result of migration, conflict and alliances about which little is known given the paucity of written historical sources and the lack of knowledge of traditional oral sources. It was thus to this unknown multicultural context that representatives of European countries travelled in order to begin what later became known as the "distribution of Africa" or the "race for Africa".

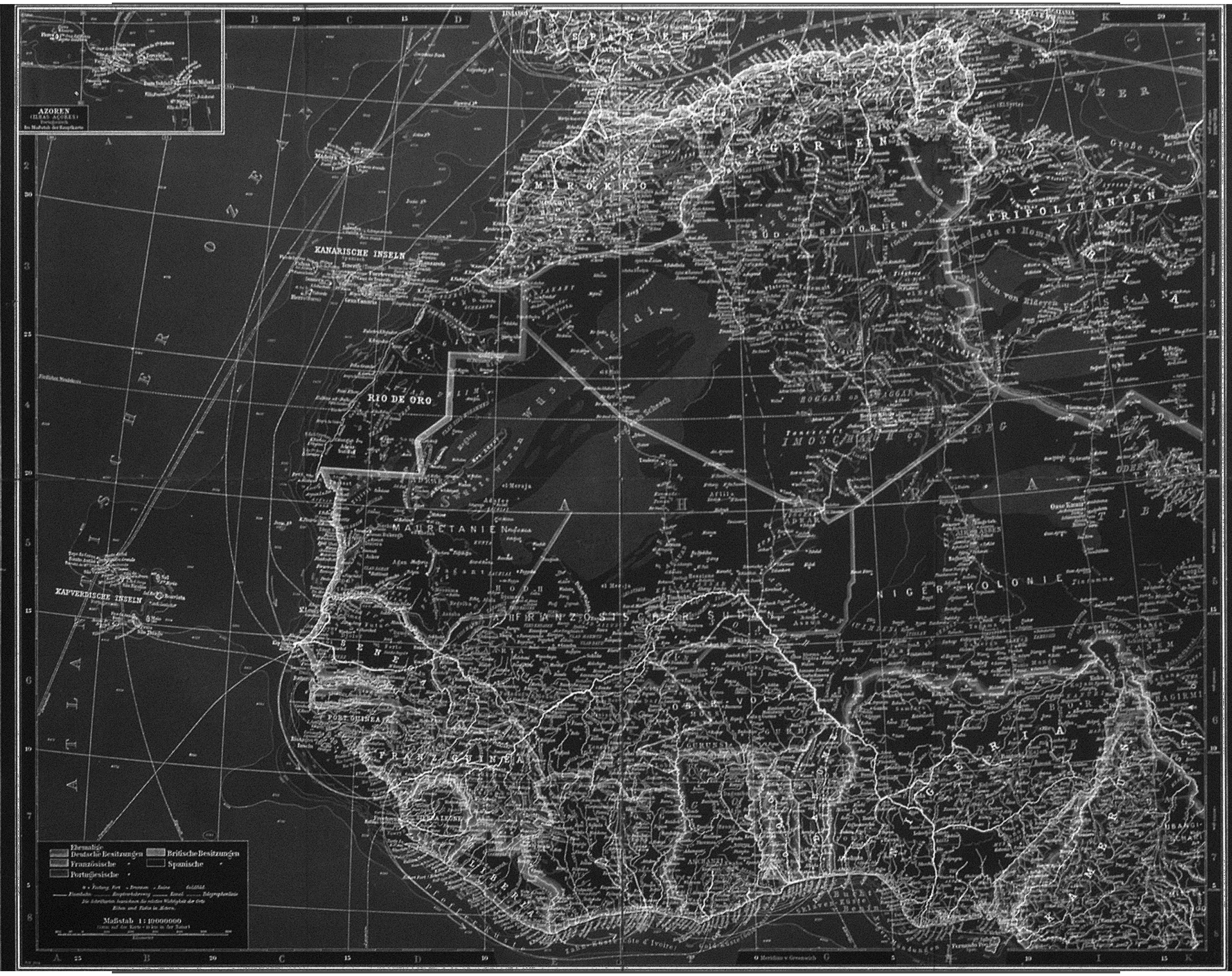
Following the conflict between Great Britain and France to establish alliances and free trade agreements with the different peoples of the territory and breaking the agreements

4 Michel Izard, "Introduction à l'histoire des Royaumes Mossi", *Recherches Voltaïques*, vol. 12, (París-Ouagadougou: Centre National de la Recherche Scientifique, 1970): 11-12.

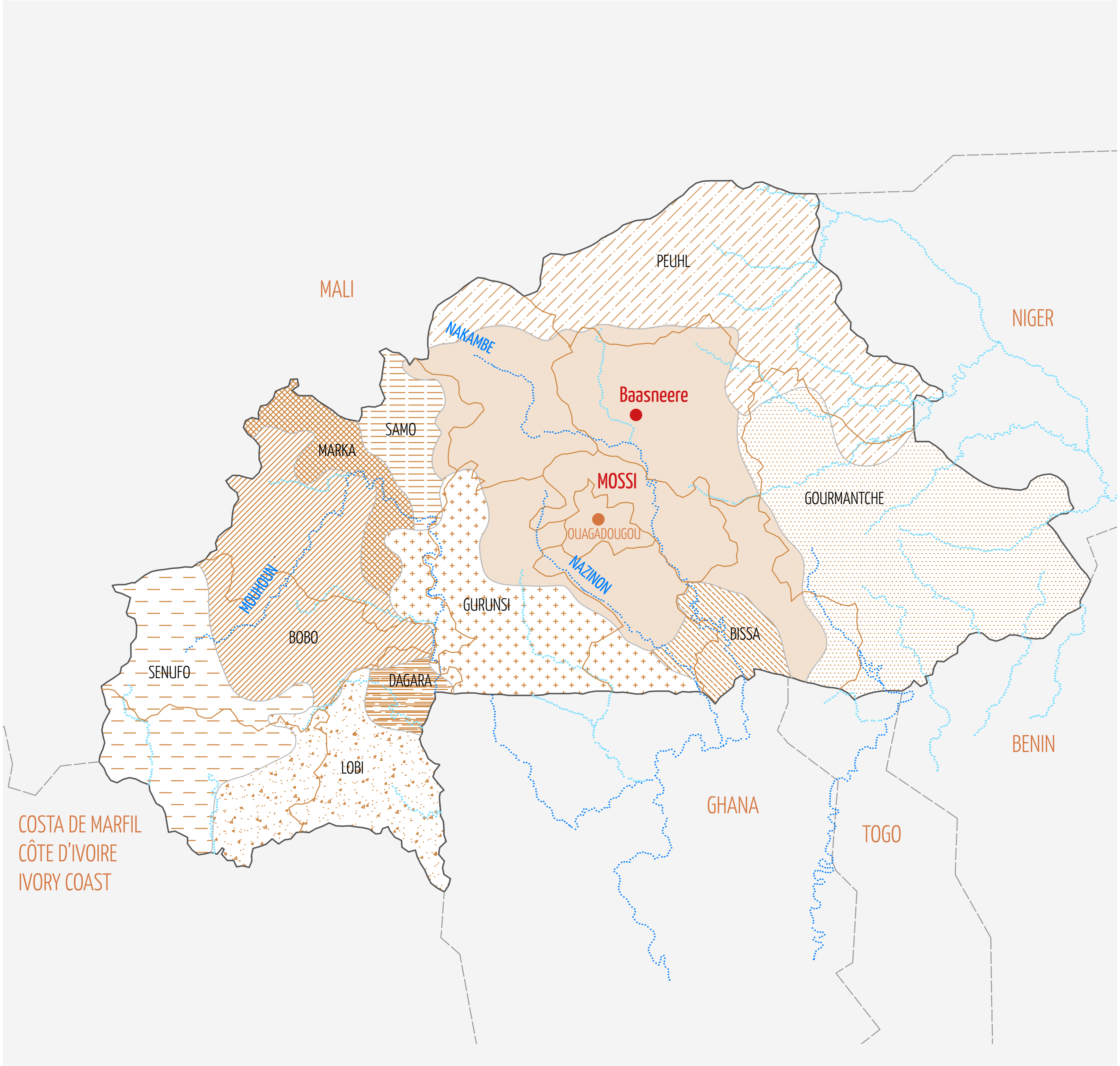
5 Ki-Zerbo 2011, op. cit.: 366.

6 Dominique Zahan, "Pour une histoire des mossi de Yatenga", *L'Homme* 1, nº 2 (1961): 6.

7 Izard 1970, op. cit., p. 13-16.



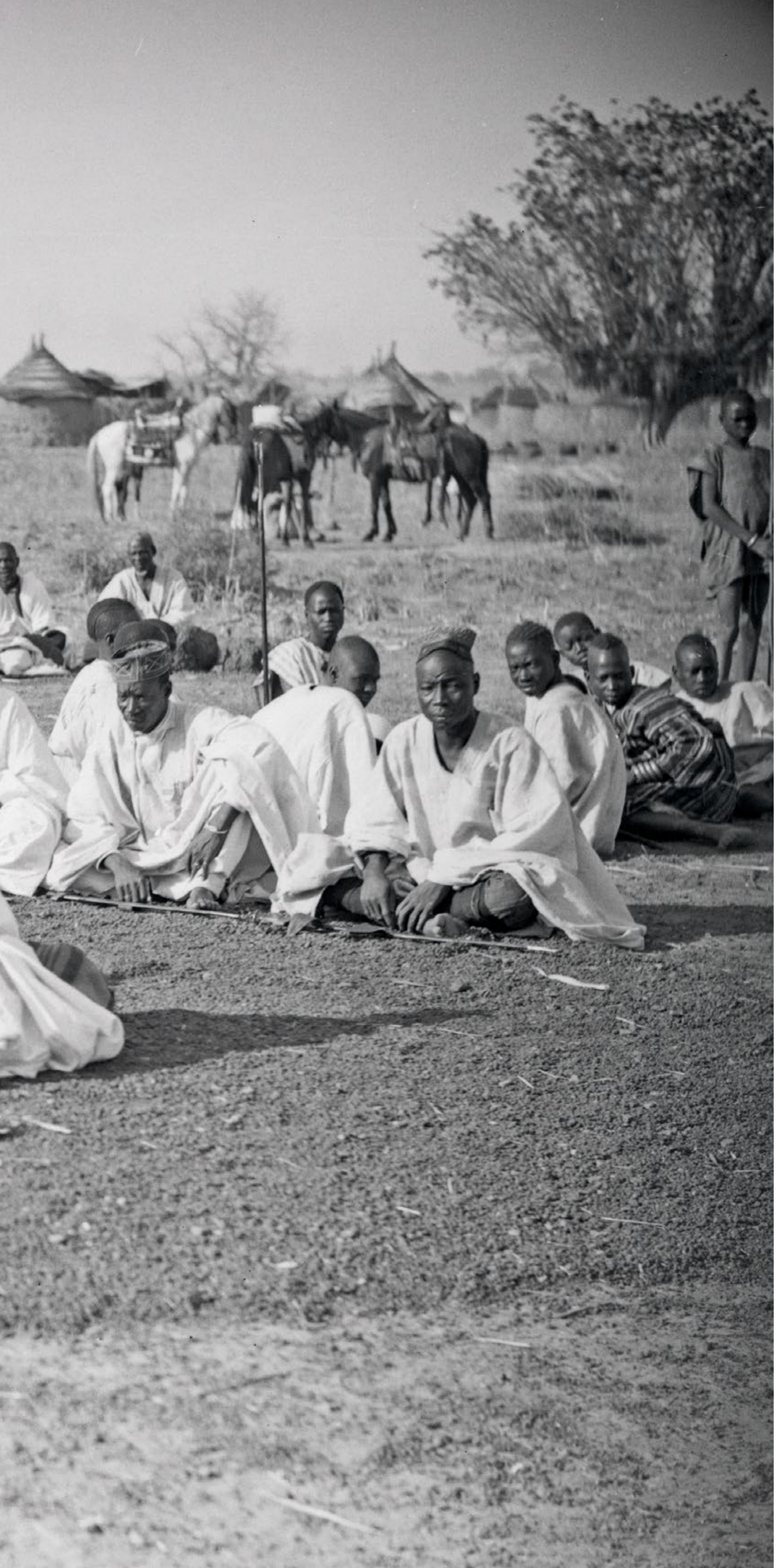
Plan of the partition of Africa.



Approximate distribution of cultures found in the territory of Burkina Faso.

Ouagadougou, 1932.

The chiefs discuss government business while passing round and sharing a bowl of tea, 1930.



signed with Great Britain, the French finally imposed their power conquering Ouagadougou in 1896 using Senegalese and Bambara troops.[8] The occupation was complete in under four years and the borders were established in the fourth year.[9]

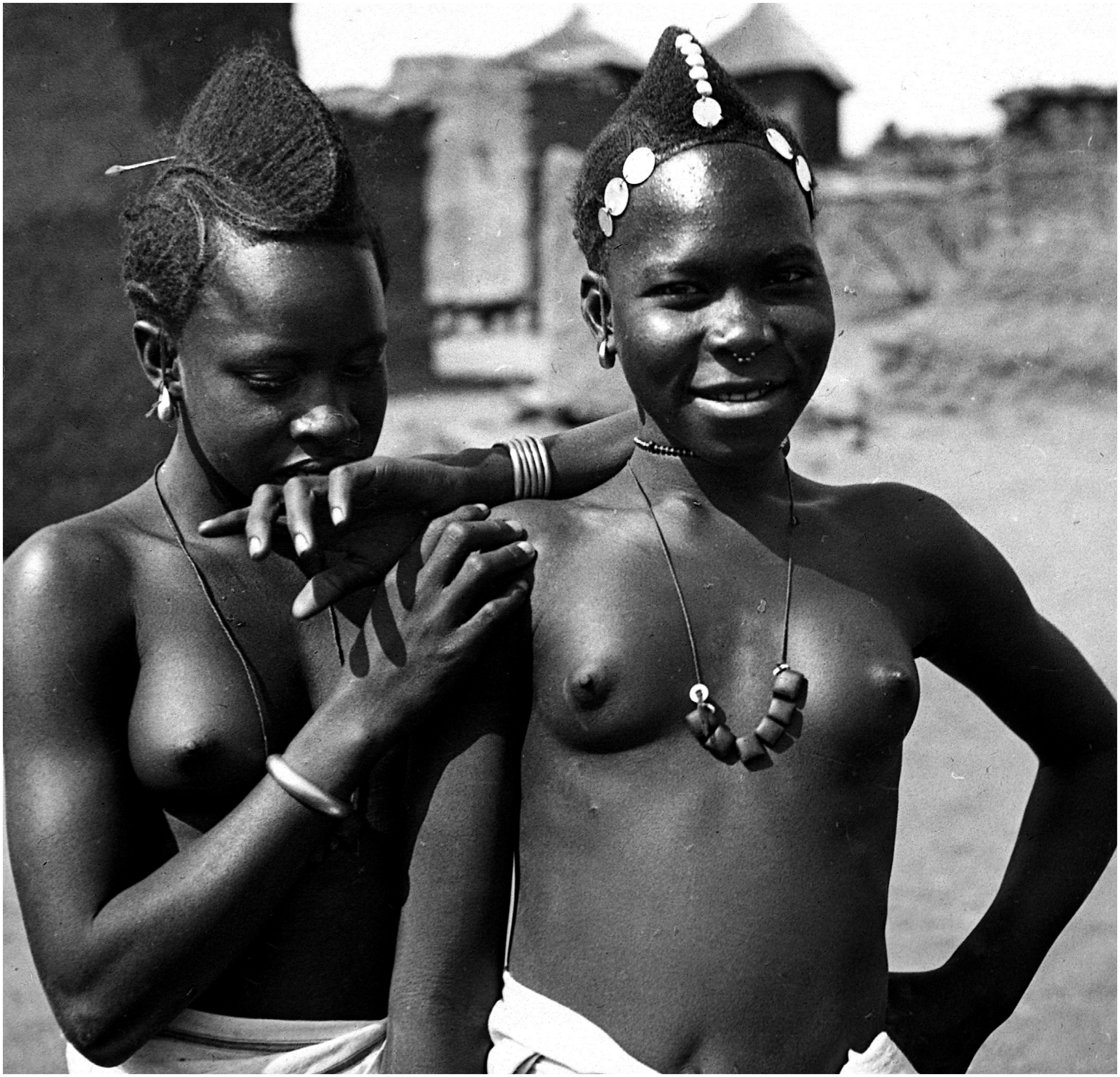
In 1919 the territory known as Upper Volta appeared officially as a colony of French East Africa along with the Ivory Coast, Dahomey (currently Benin), French Guinea, Mauritania, Senegal, French Sudan (now Mali) and French Togoland (now Togo). In 1932, however, it seemed more convenient to France to divide this colony with no coastal access and little production compared to the rest of colonies. Upper Volta was distributed between French Sudan, Niger and the Ivory Coast, and its inhabitants were forced to emigrate in order to work the land in neighbouring colonies.

The highest concentration of Mossi workers was in the Ivory Coast where planters needed abundant and cheap labour.[10] In fact, these population flows from Burkina Faso to the Ivory Coast remained over time and then became customary, as Suzanne Lallemand has

8 Izard 1970, op. cit., p. 627.

9 Ki-Zerbo 2011, op. cit., p. 607.

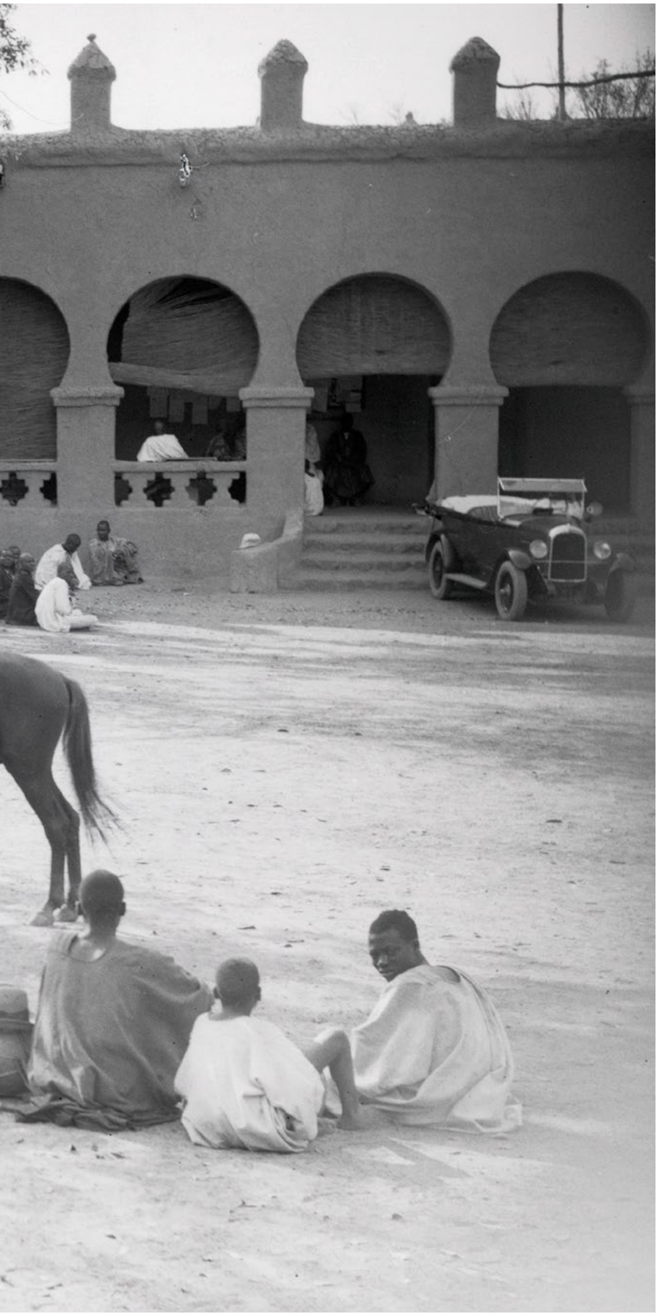
10 Ibid., p. 760.



Peul girls in a village north of Ouahigouya, 1933.

Musicians in the Court of the King of the Mossi, 1930.

In the Court of the King of the Mossi, 1930.



pointed out.[11] The accounts of some men in Baasneere confirm that emigration in search for work in the neighbouring country is still often found today.

The dissolution of the colony, mass migration of the population to other territories, the forced labour regime suffered in neighbouring territories, and the compulsory participation of men as a corps of the French army in the Second World War did not prevent the traditional chiefs from conserving the identity and autonomy of their peoples. After the war, a group of chiefs from the former Mossi kingdom of Yatenga began a campaign to convince the National Assembly of Paris to re-establish Upper Volta. The French government finally elected to send a representative to determine whether the population was in agreement with this.[12]

Whether due to the favourable result of this report or the desire to halt the anticolonialist advance of Houphouët-Boigny and the RDA (*Ressemblement Démocratique Africain*), with increasing representation in the Ivory Coast, Upper Volta recovered its status as a French colony in 1947, holding its first elections two years later in 1949.

These elections marked the start of a slow process through which power gradually passed from the hands of the traditional chiefs to politicians in the newly formed parties. In fact, these parties were actually born as representatives of the different cultural groups, led by those whose economic and

[11] Lallemand, S. « Une famille mossi ». *Recherches Voltaïques*. Vol. 17 (CNRS: Paris, France, 1977).

[12] Skinner, Elliot P. *The Mossi of the Upper Volta: The Political Development of a Sudanese People* (Stanford, California: Stanford University Press, 1964), 183-184.

social status met the conditions required to found a party. In addition, the rural populations were reluctant to change and even now the figure of the traditional chief maintains its authority. For these populations the re-establishment of the colony and the holding of elections did not signify the gaining of civil rights but rather the end to forced labour outside the territory.[13]

On 5 August 1960 the colony gained its independence from France. In the ten years following the first democratic elections, anticolonialist ideas had spread to the different political parties in the country, just as they had in all the other French colonies in West Africa. Finally, circumstances both inside and outside the country led to Maurice Yameogo becoming the first president of the Republic of Upper Volta.

Future prospects

Following the establishment of the republic, the first elections with direct universal suffrage were held on 28 July 1964. However, a period of instability followed the democratic process, with several coups and referendums leading to the formation of a Second (1970) and Third (1975) Republic of Upper Volta.[14]

The intervention of members of the army in political activity was increasing and coups became the way to reach the presidency. After one such coup in 1982 there was a split in ideology between those who had taken part in the uprising so that the more progressive faction, which included Henri Zongo, Jean-Baptiste Boukary Lingani, Thomas Sankara and Blaise Compaoré, was persecuted and incarcerated.

[13] Skinner 1964, op. cit., p. 189.

[14] Bernard Zongo, *Parlons Mooré: Langue et culture des mossi* (Paris: L'Harmattan, 2004), 18.

Traditional housing undergoing change in the Tiébélé region.

On 4 August 1983, Blaise Compaoré took power. At the head of the National Council for the Revolution, as first minister of the new government, was Thomas Sankara whose speech before the General Assembly of the United Nations in defence of the dignity of his people attracted the attention of the representatives of the remaining countries.[15]

On his arrival to power, Sankara took a series of measures which, like his words, were surprising for their unexpected realism and coherence. His main objectives were to fight corruption and ensure the austerity of a rich and privileged political class in one of the poorest countries in the world. He also implemented initiatives for promoting education, boosting local economic development, and improving the situation of women in society. On the first anniversary of the revolution, to boost the morale and trust of a population undermined by instability, Sankara gave the country the name of "Burkina Faso". Thus, in a single name he united the three main languages of the country: More (language of the Mossi), Diula (language of the ethnicities of the Mande culture) and Fulfulde (language of the Peul). In Mooré the term *burkina* means "integrity" or "honour" while the Diula term *faso* means "territory" or "land". From that point on, the inhabitants of Burkina Faso became the *Burkinabè*, that is, the "citizens" (*bè* in Fulfulde) of the "integrity" (*burkina* in Mooré).[16]

However, the hope that sprung in the Burkinabè with the arrival of this new government soon disappeared when on 15 October 1987, in his third year in power, Thomas Sankara was murdered during

Dwellings in the Burkinabe savanna dotted with thatched granaries.

[15] Thomas Sankara, *Somos herederos de las revoluciones del mundo: Discursos de la revolución de Burkina Faso 1983-87* (Atlanta: Pathfinder Press, 2007), 10.

[16] Zongo 2004, op. cit., p. 11.

a coup initiated by his former friend and colleague, Blaise Compaoré. In time, all the former members of the political revolution started in 1983 by Sankara were tried and executed and Compaoré remained in power for 27 years, abolishing all the measures put into place by the previous government. Sadly, the poverty denounced by Sankara in his speech before the General Assembly of the United Nations in 1984 has not improved greatly in over 30 years and Burkina Faso remains one of the countries with the lowest Human Development Index in the world.[17]

In 2014 a new coup and a civil revolt ended the rule of dictator Compaoré. Since 2015 Burkina Faso has had a democratically elected president, but its history as a colony created, dissolved and recomposed, the instability of its governments, successive coups, the assassination of a president beloved by his people, corruption, the exploitation of natural resources by foreign companies with the connivance of a dictatorial government, have left an imprint that is hard to erase in a country that already seems exhausted and apathetic with regard to its future.

Fortunately, this may only be in "appearance" as the Burkinabè youth continues to believe that, despite it all, better prospects are possible. The words of Sankara can still be read on the streets of Ouagadougou and theatre festivals are a reminder of the verses of the writer Aimé Césaire, poet, playwright, intellectual and politician from Martinique, ideologist of the concept of "blackness" and defender of African roots, with a great influence in the decolonizing movements in Africa. These ideas of freedom and justice are found

[17] United Nations Development Programme (UNDP), Índices e indicadores de Desarrollo Humano. Actualización estadística de 2018 (Nueva York: PNUD, 2018) (http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update_es.pdf

Peul women around the village of Baasneere.

among young people and there lies the potential to reverse the situation and work towards the development of a united country.

Between the extremes of Sahara and the Atlantic

Geographically, Burkina Faso is situated between the 10N and 15N parallels, on a large plateau 300 m above sea level. In this territory only some elevations close to 500 m stand out, as in the case of the hills of the volcanic massif that goes from the region of Yako, along the region of Tikaré, to the region of Kaya,[18] close to the village of Baasneere.

As in the rest of West Africa the country is subject to the influence of two large opposing masses of air: a colder and more humid maritime one from the Atlantic Ocean and a drier warmer one of continental origin from the Sahara Desert. The oscillation and meeting of both masses leads to two alternating seasons in stark contrast in the country: the dry season and the rainy season. Furthermore, as air currents move from southeast to northwest and vice versa, this alternation progresses so that the south, which is closest to the Atlantic, receives the rainy season first, enjoying it for longer. To the north in the Sahel the dry season due to the influence of the Sahara lasts for much of the year. Thus, the Burkinabè territory is divided into three climate zones (Saheline, Sudano-Saheline or transition zone, and Sudanese) defined by annual rainfall and temperatures.[19]

This translates into a general savanna landscape which to the north is more similar to a desert area while to the south it is akin to a wet tropical region with sparsely populated forests. In addition, regardless of the climate zone, the landscape of individual regions varies between the rainy season, when everything is covered in green and paths turn into small streams, and the dry season, when the ochre and reddish hues of the barren land dominate.

Moving northwards the forest thins out, becoming trees and dispersed thickets. These gradually diminish until they are replaced in the far north by the savanna, precursor of the desert. Just as the vegetation in the region indicates a transition between the exuberant forests and desert, so does the climate. In the rainy season, from May to September, almost 250 mm of rain falls a month and the humidity rises to over 70 per cent; the whole area is covered by vegetation. In the south the trees are indistinguishable, entangled by creepers and climbers; the lower vegetation becomes so thick that you can only move on the paths, which have to be constantly cleared to avoid being swallowed up by the jungle.

Further north, where trees are scarce, three-metre-high elephant grass moves in the breeze. Rainwater runs in impromptu streams

[18] Izard 1970, op. cit., p. 8-10.

[19] Adjima Thiombiano y Dorothea Kampmann (eds.), *Atlas de la Biodiversité de l'Afrique de l'Ouest. Tomo II: Burkina Faso* (Ouagadougou & Frankfurt/Main, 2010), 122-124.

which form rivers and every hollow becomes a lake. In the dry season, which finishes between December and January, the whole picture is transformed. The lush green hues of the rainy season become dry yellows and browns; there is hardly any rain and humidity goes below 20 per cent. The hot dry dust covers the red plains of laterite in a cloud which cuts visibility down to less than two kilometres. The rivers dry up and the riverbed collapses under the cracks which mark where water was before. Emaciated cows with large horns search for shelter under the few trees among the dry stubble of what was once grass. A spark is enough to start off a fire in the shrub lands spreading rapidly through the grass and dry shrubs, reducing them to burning ash. The ash lies there until the next rainy season, when it is turned by the farmers using primitive manual ploughs and used as fertilizer, the only kind that this soil has ever known. Thus, the cycle is completed as it has been for centuries.[20]

This description by Babar Mumtaz, written in 1969, differs slightly from the current situation. At present, the dry season is increasingly longer and extreme in the north of the country, due to the growing desertification threatening the states found within the Sahel.[21] The arid infertile soil is a problem which has led the FAO (Food and Agriculture Organization) to set up a programme of Action against Desertification, proposing the creation of a Great Green Wall in the Sahara and Sahel, with over 7,000 green hectares already restored in Burkina Faso.[22]

As regards the composition of the soil, a large part of the country's surface is covered by laterite. This clayey, usually reddish, soil is widely used in construction both in its earthen and rock varieties. As trees are particularly scarce, especially in the strip of territory belonging to the Sahel and its immediate surroundings, they are even more appreciated for the shade and protection than as a source of material for construction. A material resource that is available in abundance throughout Burkina Faso is earth, a key element in the vernacular architecture of most of the country's cultures.

[20] Babar Mumtaz, "Aldeas en el Volta Negro", *Cobijo y sociedad*, editado por Paul Oliver (Madrid: H. Blume Ediciones, 1978), 89.

[21] "La desertificación en la zona sudanosaheliana del África occidental", Jean Gorse, FAO - Organización de las Naciones Unidas apara la Alimentación y la Agricultura. Acc. 1/6/2019. (http://www.fao.org/3/r5265s/r5265s02.htm#TopOfPage)

[22] "La ciencia combate la desertificación en el Sahel: El asombroso trabajo de una joven microbióloga de Burkina Faso", FAO - Organización de las Naciones Unidas para la Alimentación y la Agricultura. Acc. 01/06/2019 (http://www.fao.org/fao-stories/article/es/c/1179862/)

Fretwork curved wall at Kaya Polytechnic.

2. Cooperation architecture

Definition and antecedents

Cooperation architecture is a term used to refer to architecture designed and built in a context of development cooperation. It often has an international component, either because it comes to be outside the country, through non-native architects or using foreign funding.

It is usually understood, especially recently, that this architecture pays attention to climate, forms, materials, constructive tradition, and local culture, to at least reinterpret them in the building to be designed rather than to imitate them. It is also frequent for at least part of the design and construction process to involve the residents or future users of the building taking part.

A notable pioneer in this type of architecture is Egyptian architect Hassan Fathy, whose work, mostly in Egypt, favoured traditional and inexpensive constructive materials such as sundried adobe. He also rescued millenary techniques such as the Nubian vault from oblivion to create a simple modern architecture which continues to prompt admiration today. Examples of this are New Gourna (1948) and New Baris (1967), both in Egypt.[23] His work was partly continued by later students such as the British-Iraqi architect Salma Samar Damluji.

Another interesting case is that of British architect – and later Indian national – Laurie Baker, who worked extensively in Nepal and India and is a major point of reference in the Asian subcontinent and beyond. After meeting Gandhi in the 1940s, Laurie Baker devoted his life to the design and construction of a kilometre zero architecture at the service of society, highlighting low cost, sustainability, lighting, ventilation, and optimization of space without having to compromise on freshness and the creativity of his organic solutions.[24]

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[23] Fathy, Hassan. 1973. *Architecture for the poor. An Experiment in Rural Egypt. Chicago: University of Chicago Press*; Damluji, Salma Samar. 2018. *Hassan Fathy: Earth & Utopia*. London: Laurence King Publishing; El-Wakil, Leïla (ed.). 2018. *Hassan Fathy. An architectural life*. Cairo/New York: AUC Press.

[24] Bhatia, Gautam. 2003. *Laurie Baker: life, work and writings*. London: Penguin Books; Deulgaonkar, Aturl & Dambhare, Makarand. 2020. *Laurie Baker: truth in architecture*. Pune: Jyotsna Prakashan; Baker, Laurie. 1988. *Brickwork*. Thrissur, Kerala: Centre of Science and Technology For Rural Development-Costford; Baker, Laurie. 1997. *Cost reduction for primary school buildings*. Thrissur, Kerala: Costford; Baker,

Baker built hundreds of residential, service, and social buildings, and hospitals in the state of Kerala in the south of India. He also wrote a dozen small guides and manuals about the design and construction of cheap housing with an effective use of energy consumption.

French architect André Ravéreau reinterpreted vernacular architecture in Algeria and Mali to design a contemporary architecture more in keeping with its physical and human surroundings.[25] His work includes the medical dispensary of Mopti (Mali, 1976) and the neighbourhood of Sidi Abbas in Ghardaia (Algeria, 1986). Italian architect Fabrizio Carola, who worked in the countries of West Africa, especially Mauritania and Mali, shunned the use of modern Western materials in favour of vaulted solutions using very few means which he learnt first-hand from Hassan Fathy.

Other renowned architects within this trend who use simple materials and locally available resources include Dutch architect Johan van Lengen (1930-2021), resident in Brazil, founder of the Instituto de *Tecnología Intuitiva e Bioarquitectura* and author of the *Manual del arquitecto descalzo.*[26] This guide for the design and construction of ecological, affordable, and sustainable housing for different climates has been used as support and reference for many cooperation development architecture initiatives.

In addition, Spanish-born Mexican architect Óscar Hagerman (1936) has devoted his life to the design of buildings for indigenous communities, based on their own formal, constructive, and cultural tradition, and setting a coherent and genuine example of how to carry out cooperation architecture.[27]

Some notes on the international panorama

After the work of these pioneers, cooperation development has almost become a major discipline or field of experimentation, where it is even possible to find numerous architects specializing in this type of project. Indian architect Anupama Kundoo (1967), moving between India and her residence in several European countries, has developed interesting architectural proposals based on the constructive knowledge of earthen architecture

Laurie. 1996. *A manual of cost cuts for strong acceptable housing*. Thrissur, Kerala: Costford; Baker, Laurie. 1999. *Rubbish*. Thrissur, Kerala: Costford; Baker, Laurie. 1997. *Rural house plans*. Thrissur, Kerala: Costford; Baker, Laurie. 1997. *Rural community buildings*. Thrissur, Kerala: Costford; Baker, Laurie. 1997. *Are slums inevitable?* Thrissur, Kerala: Costford; Baker, Laurie. 1988. *Mud*. Thrissur, Kerala: Costford; Baker, Laurie. 1986. *Houses. How to reduce building costs*. Thrissur, Kerala: Costford; Baker, Laurie. 2016. *What is an architect?* Thiruvananthapuram, Kerala: Costford & LBC; Baker, Elizabeth. 2007. *The other side of Laurie Baker*. Kerala: DC Books; Pillai, Jayesh S. (ed.). 2014. *Masterpiece of a master architect*. Centre for Development Studies. Thrissur, Kerala: Costford & Laurie Baker Centre for Habitat Studies.

[25] Ravéreau, André. 2007. *Du local à l'universel*. Fermanville, FR: Éditions du Linteau; Ravéreau, André. 1981. *Le M'Zab, une leçon d'architecture*. Tunis: Sindbad.

[26] Van Lengen, Johan. 1980. *Manual del arquitecto descalzo. Como construir casas y otros edificios*. México D.F.: Concepto S.A.

[27] Yampolsky, Mariana & Hagerman, Óscar. 1995. *Casas acariciadoras: arquitectura rural*. Belém: Fundaçao das Descobertas, Centro Cultural de Belém; Poniatowska, Elena & Vera & Paloma (eds) Hagerman, Óscar (autor). 2010. *Óscar Hagerman. Arquitectura y diseño*. Ciudad de México: Arquine; Tovar Rendón, Jesús Armando. 2019. *Óscar Hagerman: maestro de la arquitectura social*. Amazon Kindle.

Noomdo Orphanage (Koudougou, Burkina Faso), designed by Francis Kéré.

and the ceramic tradition of her country of origin.[28] Also, Nepalese architect Nripal Adhikari (1980), from the Abari studio and foundation, develops architectural solutions with a strong social component, based on the use of earth and bamboo as main constructive materials, as well as writing construction manuals.[29] Western architects who are well-known for having worked at some point in this field from their countries of origin include the now-disappeared Norwegian

[28] Appadurai, Arjun; Bose, Shumi; Thorne, Martha; Jorgensen. 2020. *Anupama Kundoo: Taking Time: The Architect's Studio*. Zürich/Humlebaek: Lars Müller Publisher/Louisiana Museum of Modern Art; Kundoo, Anupama. 2018. "Freedom from the Know: Imagining the Future Without the Baggage of the Past." *Architectural Design* 88.3: 54-61; Kundoo, Anupama, and Cecilia Obiol. 2014. "Rethinking materiality. Building voids with less resources. Excerpts from a lecture by Anupama Kundoo." *Palimpsesto*, 11: 4-5.

[29] Adhikari, Nripal. 2016. "Vernacular architecture in post-earthquake Nepal". *International Journal of Environmental Studies* n. 73 (4): 1-8. Adhikari, Nripal. 2018. "Earth and bamboo: experience from Nepal". *Proceedings of the conference Kerpiç'18. Back to Earthen Architecture: industrialized, injected, rammed, stabilized*, 1st-2nd June 2018. Oğuzeli/Gaziantep: Hasan Kalyoncu University, Kerpiç Network. http://abari.earth/

Detail of the brick bond in the walls of the houses of Karimadom Colony, Trivandrum (India), designed by Laurie Baker.

New Gurna, Al Qarnah (Egypt), designed by Francis Kéré.

studio TYIN Tegnestue in Thailand,[30] Finnish architects Hilla Rudanko and Anssi Kankkunen in Cambodia,[31] and the Dutch architect Anne Feenstra (1967) in Afghanistan,[32] all combining participatory processes and creativity with local labour and materials.

Other major architects can be found in the field of cooperation architecture in Africa. These include Diébedo Francis Kéré (1965), who will be examined later, and South African Peter

30 Balzani, M., Marzot, N. 2010. *Architecture per un territorio sostenible. Città e paesaggio tra innovazione tecnológica e tradizione*. Milano: Skira: 90-93.

31 Gauzin-Müller, D. 2011. "Travail de mémoire. Centre de formation Sra Pou à Oudong, Cambodge". *EgologiK* n. 23: 108-116.

32 Feenstra, Anne. 2020. "Is it time to re-think the fundamentals of creating architecture". *Stirworld*. See. *Think. Inspire. Reflect* n. 06. 19/12/2020. Acc. 30/01/2021 (stirworld.com).

School built by Abari in Dhulikhel, Nepal.

Rich (1945), who along with Tim Hall and Michael Ramage, his colleagues from Light Earth Designs, has designed buildings based on the use of CEB vaults in South Africa, Rwanda, Uganda and Ethiopia.[33]

Other famous African architects practise a mostly Westernized architecture which takes varying degrees of inspiration from the local culture but could not be classed as cooperation architecture. Tanzanian-born architect David Adjaye, who is resident in the United Kingdom and has worked in Ghana, Nigeria and Gabon, tries to champion African culture in combination with Western influence. Nigerian-born Kunlé Adeyemi (1976) from the NLÉ studio is based in the Netherlands and works primarily in Nigeria and Tanzania, trying to provide an alternative vision for the development of Africa. Other examples include South African Mokena Makeka, who has worked in South Africa and Tanzania, and Lesothan Mphethi Morojele, from MMA Architects and with a studio in South Africa, who has developed projects in South Africa, Ethiopia, Lesotho, Uganda, and Botswana.

Housing and workshops built by Abari in Dhulikhel, Nepal.

Other architects or architecture studios originally based outside Africa stand out for their cooperation architecture in Africa. In

[33] Falvo, Rosa Maria. 2017. *Peter Rich: Learnt in Translation*. Milano: Skira; Noble, Jonathan. 2021. *The Architecture of Peter Rich: Conversations with Africa*. Islington: Lund Humphries Publishers Ltd.

Mapungbuwe Interpretation Centre, designed by Peter Rich Architects.

this case, the list would be endless given the number of initiatives, NGOs, and architects, sometimes anonymous, who have worked, even occasionally, in African countries. This is the case of MASS Design Group, set up in the United States in 2008, which has carried out projects in Rwanda, Democratic Republic of Congo, Liberia, Malawi, Zambia, Uganda, Lesotho, and Tanzania, always employing an environmentally friendly perspective although not always linked to local forms or constructions. Spanish architect Urko Sánchez (1970), resident in Kenya, is responsible for constructions in Kenya, Djibouti and Somalia, and often resorts to local constructive materials and techniques and forms derived from the vernacular tradition; Anna Heringer (1977), originally from Germany, is better-known for her work in India, Bangladesh or China, and taking inspiration from arts and crafts, earth as a constructive material, and the resources and trades available, has designed buildings in Zimbabwe, Morocco and Ghana.[34] Finally, two architects based in Burkina Faso whose work will later be explored in further depth, Albert Faus (1972) from Barcelona and Chiara Rigotti from Turin.

Most of these built examples of cooperation architecture are based on timeless forms of construction taken from vernacular architecture or occasionally imported from other constructive traditions in a phenomenon known as indigenization, which seeks to import know-how from abroad combined with local materials to improve the living conditions of the residents in a given place.

Although this is not a mathematical rule there is a suggestion of some level of difference between cooperation architecture designed by architects from the country in question and Western architects executing a project for these contexts.[35] Indeed, just as it is more difficult to find genuine examples of cooperation architecture by local architects, their use of modern materials or imported ones such as cement, concrete and metal structures is more uninhibited. In contrast, Western architects, taking inspiration from an exotic foreign culture seek creativity through local techniques, traditions, and materials, albeit sometimes unsuccessfully.

Burkina Faso: From colonial buildings to the first cooperation architecture

The Berlin Conference (1884-1885), where several Western countries regulated the distribution of colonial expansion in Africa, also marked the start of the creation of colonial architecture in the African continent. From the 16th century until then this had been limited to the construction of some defensive fortifications on the coast, mostly constructed by the Portuguese. In this distribution of territories, the future territory of Burkina Faso was assigned to France, although its inland position with no coast caused some delay to the process of colonization.

The creation of the former colony of Upper Volta in 1919 led to the establishment of institutions suited to the new system and its leaders. The "European-style" architecture of these buildings, initially with some degree of adaptation to surroundings, and later with the almost exclusive use of imported industrialized materials, initiated a slow process in which foreign forms of construction were becoming increasingly accepted as a sign of modernity

[34] Heringer, Anna, Howe, Lindsay Blair, Rauch, Martin. 2019. *Upscaling earth. Material process catalyst*. Zürich: Gta Verlag; *Arquitectura Viva. Proyectos* n. 61. 2014. Dossier Anna Heringer; *Architectural design* n. 6. Vol. 77. 2007. Made in India; *Architectural Record* n. 5. Vol. 204. 2016. Architecture and creativity; *Architectural review* n. 1375. Vol. 230. 2011; *Architectural review* n. 1335. Vol. 223. 2008; *Architectural review* n. 1342. Vol. 224. 2008. Emerging Architecture; *Architectural review*. n. 1318. Vol. 220. 2006. Emerging Architecture; *Architectural review* n. 1329. Vol. 222. 2007. Aga Khan Award for Architecture; *Arquitectura Viva* n. 171. 2015. El arte de la realidad; etc.

[35] Vegas, F.; Mileto, C.; Guimaraens, G.; Navalón, V. 2014. "Parameters of vernacular sustainability throughout the 20th century" in Correia, M.; Dipasquale, L.; Mecca, S. 2014. *Versus: heritage for tomorrow. Vernacular knowledge for sustainable architecture*. Firenze: Firenze University Press: 83.

and progress.[36] Thus, despite Europe's increasing loss of political power in Africa, its cultural influence did not wane.[37]

The transfer of ideas, styles and forms of construction was maintained even though in most cases this influence entailed an economic dependency on foreign countries which did not seem viable.

After the break-up of the colony in 1960 and the establishment of the first Republic in 1964, Burkinabe politicians had already accepted this modern architecture as their own. Removed from the traditional housing of Mossi kings, in 1965 the French architect Foblé designed the residence for the first president of the republic, Maurice Yaméogo, in the city of Koudougou. The Yaméogo Palace, now abandoned in ruins, was an imposing construction of around 1,200 m², which in its day was used to host the meetings of the president with major African dignitaries. The design, adapted to the warm dry climate of the region with large well-ventilated open areas, was also a reflection of the postmodernist ideas favoured in European architecture at that point.

At the same time another building designed by the same architect was inaugurated in Ouagadougou. This was the current *Maison du Peuple*, an emblem of the city originally built as the headquarters of the UDV (*Union Démocratique Voltaïque*), the ruling party at the time. Three years later, following successive military coups, the former *Maison du Parti* became a public establishment managed autonomously. This building, with a capacity for 3,000 people, conference hall, tracks, pavilions, radio transmission booth, bars, and restaurants, eventually became symbolic and despite its advanced state of deterioration it is still used for concerts and festivals. Most people interpret the large spans which illuminate the inside of the building as inspired by the traditional conical roofs of Mossi architecture. However, despite some adaptation to the context, this style is characteristic of architectural trends imported from Europe.

This is partly explained by the large size intended for the new buildings. This scale had apparently not been seen in the traditional architecture of the cultural groups of Burkina Faso, so that this constituted a structural challenge for local developers. The appearance of the ideal building which was beginning to form required a design and calculation phase that was different from the almost immediate process of vernacular architecture. In a few years, official construction had become a discipline which required specialists, in this case European specialists, to introduce the structural systems with great spans into the country.[38] The

[36] Lidón de Miguel, María; Vegas, Fernando; Mileto, Camilla; García-Soriano, Lidia. 2021. "Return to the Native Earth: Historical Analysis of Foreign Influences on Traditional Architecture in Burkina Faso" *Sustainability* 13, no. 2: 757.

[37] Whyte, W. "Modernism, Modernization and Europeanization in West African Architecture, 1944-94". In *Europeanization in the Twentieth Century: Historical Approaches*; Conway, M., Patel, K.K., Eds.; Palgrave Macmillan: London, UK, 2010; pp. 210–228.

[38] Nnamdi, E. *African Architecture: Evolution and Transformation*; McGraw-Hill Professional Publishing: New York, NY, USA, 1997; p. 244.

Vaults of the Home Kisito orphanage in Ouagadougou (Burkina Faso), designed by Albert Faus.

professionalization of construction contributed to the assimilation of a concept which was decisive in the devaluation of traditional architecture: the durability of constructions. Foreign constructive materials used since colonial times (including cement blocks, industrial brick, slates, or corrugated iron) allowed for the construction of more durable buildings and their use was mandatory for construction in the cities.

The construction of major facilities from the 1960s onwards coincided with the mass exodus of population to the increasingly urban centres of cities like Koudougou, Ouagadougou and Bobo-Dioulasso.[39] According to this research,

[39] Mahama Bonkoungou, *Dynamique actuelle et perspectives urbaines de Bobo-Dioulasso*, "Mémoire de Maîtrise", Université de Ouagadougou, 1990-1991.

Bobo-Dioulasso station, 1934.

the town of Bobo-Dioulasso would have grown from 84 ha in 1897, shortly before the formation of the colony, to 1,750 ha in 1965, shortly after independence. In 1985 it reached 4,600 ha and, according to current data, it now covers an area of 13,680 ha. It therefore became necessary to have new amenities (schools, hospitals, town halls and administration headquarters, markets, shopping centres, cinemas, etc.), which were types of large-scale buildings also foreign to the constructive tradition of the country.

The Great Market of Ouagadougou, known as Rood-Woko, is a later example of this process. The building was commissioned in 1986 from the French studio DLM-Architectes, in this case collaborating with a local company, AAED (Sawadogo).[40] The large bare concrete structure is reminiscent of Brutalist design and is again a reflection in Burkina Faso of the buildings being constructed in France at the time. This French studio had worked on projects in the neighbouring Ivory Coast, including the design of the airport (1969), the French cultural centre (1972), Treichville market (1979), the UPDEA headquarters (1985), and the Nestlé industrial headquarters in Abidjan (1990).

As mentioned earlier, there had been and continued to be a transfer of ideas, styles, and forms of construction from Europe to Africa based on intercontinental relationships which, although initially imposed, were later maintained.

These ideas were inevitably also transferred to smaller-scale buildings, affecting the construction of housing in cities. Although in the domestic sphere vernacular architecture had traditional responses, the social changes that were taking place in the way of life of its residents required transformations in how their dwellings were built. In addition, the availability of surface area and urbanistic and building regulations in cities were conditioning factors. The Building Law of 1960, which followed the guidelines in place during French occupation,

Residence of Maurice Yaméogo in Koudougou (Burkina Faso), designed by Foblé.

established the possibility of obtaining a *Permis Urbain d'Habiter* (PUH) solely for dwellings with a toilet and at least 12 sheets of corrugated iron. The new industrialized materials made it possible to build tall buildings, in an attempt to resolve the increasing population concentration in Ouagadougou and Bobo-Dioulasso.

[40] "Marché, Ouagadougou, Burkina Faso, 1986", DLM Architectes, http://www.dlmarchitectes.fr/projets-3 (acc. 25/02/2020).

Yaméogo Palace in Koudougou, designed by Foblé.

However, this new form of construction brought with it energy consumption (lighting and climatization) and execution costs which most of the population could not afford. This led to a clear division between the self-constructed dwellings of most neighbourhoods, which combined traditional methods and new materials, and the commissioned dwellings which show greater or lesser similarities to those found in the urban developments of European cities depending on the status or economic level of their occupants. This difference is still present today and is even more evident when comparing the architecture of cities with that of rural communities which still conserve features of their constructive traditions.

In this process of transformation of the architecture, the transfer of ideas and techniques was also brought about by development cooperation. Following the independence of the colony, local administrations did not have

The Maison du Peuple in Ouagadougou, designed by Foblé.

the means to cover the needs of the growing population which was progressively abandoning the country to settle in cities. The country then became structurally dependent on international aid and imports.

Established officially after the Second World War, international development cooperation was understood as a unidirectional transfer of technology and resources. The level of development of a country was measured based on its Gross Domestic Product (GDP) and was therefore considered an economic matter. The first cooperation projects focused especially on large-scale infrastructures built with imported materials. In these early stages the envelope or container of the service was considered less important than the functions that it had to fulfil so that any new constructions followed the designs produced by the countries providing the aid, to be built as cheaply as possible using industrialized materials known in Europe.

The dome used as a device in the Museum of Music in Ougadougou, designed by ADAUA.

The appropriate technology movement and its influence in Burkina Faso

However, this cooperation model raised some questions in the international panorama during the 1970s. The oil crisis and the famous report *The Limits to Growth* caused beliefs in progress to shake. At that point, the famous essay by Ernst Friedrich Schumacher *Small is Beautiful: A Study of Economics as if People Mattered* (1973),[41] defended the need to place economy and technology at the service of humans. Applying this philosophy led to the theory of Appropriate Technologies (AT), which arose and were put into practice in local surroundings and on a human scale. This theory became the general framework for the cooperation approaches promoting sustainable development. Not only was it essential to cover the basic needs of the population but also to guarantee the future welfare state. In the field of construction this entailed the use of the natural resources and local labour available.[42]

This change in the interpretation of cooperation projects coincided with modifications in the idea of development itself. This began to be evaluated with indices which considered education, health and inequalities, as well as GDP. The projects, of a local nature, were geared towards small communities, collaboration, and joint work with counterpart associations, which began to be established as necessary alternatives, with the idea of justice rather than the concept of charity.

In 1975, French architect Jack Vautherin set up the Association for the Development of Traditional African Urbanism and Architecture (ADAUA), which aimed to develop an architecture and urbanism suited to the needs of the population and rooted in local constructive tradition. This association focused its work on three aspects:

- The design and construction of public buildings.
- Research for the development of materials in local constructions.
- Sociological research on the populations of the countries of the Sahel.

In Burkina Faso, ADAUA developed several projects including some in collaboration with the Egyptian architect Adel Fahmy (1946) who, after

[41] Schumacher, E.F. *Lo Pequeño es Hermoso (Small is Beautiful)*; Ed. Akal: Madrid, Spain, 2011.

[42] Folkers, A. *Modern Architecture in Africa*; SUN Architecture: Amsterdam, The Netherlands, 2010.

The National Museum of Burkina Faso in Ouagadougou, inspired by vernacular iconography, designed by Simon Kafando of Cabinet AIC.

a research trip around the country, designed several traditionally inspired buildings making use of Compressed Earth Blocks or CEBs.

The prototype of Fada dwelling in Fada N-Gourma (1983), built for the Association de la *Productivité*, attempted to incorporate the traditional complex of Mossi housing with several circular or rectangular rooms with vault or dome roofs around a central courtyard. The *Centre Matériaux* (1984) included two large laboratories with several administration offices with vault and dome roofs. The exteriors of these buildings were rendered with decoration inspired by the motifs and symbols of African masks.[43]

[43] Fahmy, Adel. 2008. "Appropiate building technology. Tradition and innovation". In Atkinson Adrian; Graetz, Manuela; Karst, Daniel (eds.). *Techniques and technologies for sustainability*. Proceedings of the International Conference and Summer School 2007. Berlin: Institut für Stadt- und Regionalplanung / Technische Universität Berlin: 67-73; http://adelfahmyadobe.com (acc. 12/02/2021).

Interior of Koudougou market (Burkina Faso), designed by Laurent Séchaud.

ADAUA also designed the University Campus of Ougadougou (1984), commissioned by the PanAfrican Institute for Development, also built with CEB walls, vaults and domes inspired by the spatial organization of Burkinabe dwellings and settlements with numerous interior courtyards. In these projects the system of domes built with stabilized CEBs on walls in the same materials resolved the problem of the structure of large spans, offering a sustainable alternative using the material characteristic of the country's traditional architecture.[44]

The actions of ADAUA in Burkina Faso and its promotion of the use of stabilized CEBs reflect an attempt to execute designs based on Appropriate Technology. However, these new proposals were only half-heartedly embraced and assimilated by the local population. Although earth was a local natural resource, the technology was still foreign and coincided with the devaluation of earth as a constructive material which had begun in colonial times. The construction of walls and vaults using stabilized earth had still not become widespread as an appropriate technology at that point.

Despite this and a series of initial events which either failed or were gradually forgotten the shift in approach of international cooperation projects translated into architectural terms into growing concern for ensuring that the buildings from these designs were adapted as much as possible to their physical and cultural surroundings. The importance of the use of local materials in

CEB vaults in Koudougou market.

well-lit and ventilated sustainable buildings with low energy consumption, and the value of the training and use of local professionals, became widespread among the architects hired by cooperation bodies from the 1990s. In short, the changes could be summarized as an increased awareness of the context they were being built for.

This change in the process could be seen in another example of a market that followed. In 1999 the Swiss Agency for Development and Cooperation in collaboration with the Development Programme for Medium-sized cities of the Burkina Faso government, hired the French architect Laurent Séchaud to design a market for the city of Koudougou.[45] In this case

[44] Amparo Casabán Garcés, *La arquitectura de tierra de Burkina Faso: Tradición e innovación*, TFG, ETSA, 2016-2017.

[45] "Central Market", Aga Khan Award for Architecture, https://www.akdn.org/architecture/project/central-market (acc. 26/03/2020).

Stalls at Koudougou market.

the difference was that, in line with development theories, the building design began with a participatory process seeking to involve the community in the choice of location and in the design itself.

The construction of the market, which used Compressed Earth Blocks (CEBs) in a vaulted system also contributed to the training of local professionals, earning it acceptance among the population and the recognition of the 2007 Aga Khan award. The participatory design process anticipated the real-scale construction of a market stall, facilitating communication between the stakeholders of the process and future users, and making it possible to finetune the design and practise the constructive techniques with local labour.

Composition, structural and constructive issues

When putting these ideas into practice, the question faced now by most of the specialists working in cooperation architecture is how to answer the demands of project developers while also preserving the relationship with local surroundings and customs.

For the construction of walls, Compressed Earth Blocks (CEBs) are considered a local alternative to the use of cement, also used by ADAUA in its projects from 1984. In addition to this material, we find carved stone or carved laterite blocks and in the more recent projects by Francis Kéré, such as the Naaba Belem Goumma Secondary School (Gando, 2011) or the

Streets inside Koudougou market.

Burkina Institute of Technology (BIT) (Koudougou, 2020), rammed earth or earth concrete. These new technologies, based on the use of local resources, can be understood as an evolution of the traditional adobe techniques, moulded or piled earth and stone. The greatest conflict lies in the constructive systems of roofs, where two aspects can be noted:

1. The large spans of public buildings have no point of reference in the country's vernacular architecture and therefore do not truly represent the continuity of the constructive tradition. Faced with this dilemma, the chosen solution for most cases is that of triangular metal trusses. There are no known examples of the use of triangular timber trusses found in other examples of cooperation architecture in other African countries, perhaps due to the scarcity of timber or its vulnerability to termite attacks.

2. The concept of durability demanded of new constructions, especially buildings resulting from international cooperation projects. With traditional solutions of earth or braided straw mats it was the norm, following rainy periods, to carry out repairs or reconstructions of roofs. The maintenance of dwellings was a family habit.

However, the temporary nature of constructions is not a concept commonly accepted for modern constructions: the buildings commissioned should be durable. In addition, cooperation projects tend to have very limited funding for the construction of buildings and do not contemplate future maintenance. There is therefore a need for roof solutions which do not requiring constant repair due to deterioration caused by rain.

The solution adopted in most of the early cooperation projects from the 1960s and 1970s in Burkina Faso, when the configuration of the building itself was not yet a concern, was the use of corrugated iron. However, given the incredibly warm climate during most of the year, and the fact that indoor ventilation was not guaranteed, this solution led to unbearable indoor temperatures.

The evolution of this solution, first proposed in Burkina Faso by Francis Kéré and already widespread in current cooperation projects, has consisted in the design of double roofs: an initial layer of CEBs or adobe in vaulted systems or flat roofs guarantees indoor thermal comfort; and a second layer of protection, generally iron sheeting or waterproof materials, protects the earth from the action of the rainwater. When using sheet metal, the air cavity that is left between it and the earthen roof helps to guarantee greater thermal insulation.

Cooperation architecture in Burkina Faso at present

Below we find a selection of some of the most notable examples of cooperation architecture over the last two decades in Burkina Faso, both in the architecture of new constructions and in urbanism, conservation, and valorization. This list is by no means exhaustive as there are many more initiatives, not included here due to space limitations.

Diébedo Francis Kéré

Pritzker Prize and also a recipient of the Aga Khan award, Burkinabe architect Diébedo Francis Kéré (1965), resident in Germany, followed this line of work with his first design for a children's school in his hometown of Gando in 2001. The architecture of Kéré, now an international point of reference, has been highlighted as pioneering given his interest in local materials and environmental awareness in cooperation projects. The cultural component is just as important in his work, as he is an architect who studied abroad, but tries to adapt contemporary language to the characteristic features of local culture.[46]

The international importance of Kéré is such that he has designed and built constructions in around 20 countries. These commissions were completed with a freshness and quality which is not always easy to find, striking a balance with the culture and local tradition which were and continue to be the inspiration for his buildings in Burkina Faso.

According to Kéré the onerous maintenance or periodic reconstruction characteristic of traditional architecture in Burkina Faso holds back progress, prompting a need for a radical review of traditional constructive methods.[47] Therefore, he introduces foreign constructive materials and techniques such as lightweight soldered trusses with round holes or corrugated bars in his buildings, reinforced concrete tension rings or beams or corrugated iron for roofs, and combines them with other traditional materials such as rammed earth or CEBs. Kéré has also gradually incorporated natural cooling systems through vegetation, courtyards, wells and water canals, wind catchers, wind turbines or several of these elements combined into his architecture.

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[46] Kéré, Francis. 2013. "School Library, Gando. Primary School Extension in Gando. Teachers Housing". *A+U* (514): 127-133; "Primary School", Aga Khan Award for Architecture, acc. 26/3/2020, https://www.akdn.org/architecture/project/primary-school; Kéré Francis. 2011. "Materia fértil". *Arquitectura Viva* n. 140: 40-43; Kéré, Francis. 2014. "Alma de cántaro". *Arquitectura Viva* n. 161: 40-43; Kéré, Francis. 2013. "Das Material as Grundlage". *Detail* n. 6: 594-599; Pallasmaa, Juhani. 2015. "El arte de la realidad". *Arquitectura Viva* n. 171: 11-18; Nasso, M. 2015. "Identità attraverso la diversità". *Domus* n. 993: 38-41; Kunsman, J. 2012. "Utopía di terra". *Domus* n. 962: 36-47; James, C. 2011. "Il Mali di Francis Keré". *Domus* n. 949: 44-51; Bossi, L. 2009. "School in Dano, Burkina Faso". *Domus* n. 927: 62-65; Zabalbeascoa, Ana. 11-02-2014. "Kéré, un arquitecto sin casa". *El País*, www.elpais.com, acc. 29/01/2021; Zabalbeascoa, Ana. 24-09-2015. "Entrevista a Francis Kéré". *El País*, www. elpais.com, acc. 29/01/2021,; Kéré, Francis. 2009. "Primary School and Extension, Gando. Secondary School, Dano". *Lotus* n. 140: 23-28; Keré, Francis. 2009. "Escuela Primaria de Gando", www.tectonicablog.com acc. 29/01/2021; Kéré, Francis. 2010. "Ampliación de escuela primaria en Dano", www.tectonicablog.com acc. 29/01/2021; Mateo, C. 2010. "Entrevista a Francis Keré". *VPOR2* n. 7: 24-27; Kéré, Diébédo Francis. "Materia vernácula, Secondary School, Koudougou, Burkina Faso: Francis Kéré." *Arquitectura Viva* 198 (2017): 36-39. Kéré, Diébédo Francis. "School in Gando, Burkina Faso." *Architectural Design* 82.6 (2012): 66-71. In addition, a complete issue dedicated to his work collected all his projects up to 2017 in *AV: Monografías* 201 (2017): Escuela Primaria de Gando, 1999-2001 (Burkina Faso); Viviendas para maestros, 2002-2004, Gando (Burkina Faso); Ampliación de la escuela primaria, 2003-2008, Gando (Burkina Faso); Escuela secundaria de Dano, 2006-2007, Dano (Burkina Faso); Opera Village, 2010-, Laongo (Burkina Faso); Centro de Salud y Promoción Social, 2010-2014, Laongo (Burkina Faso); Escuela secundaria Lycée Schorge, 2014-2016, Koudougou (Burkina Faso) Centro Quirúrgico y centro de Salud de Léo, 2012-2017, Léo (Burkina Faso); etc.

[47] Kéré, Francis D. "Harnessing traditional building techniques to produce sustainable architecture" pp. 45-37, http://src.lafargeholcim-foundation.org (acc. 10/02/2021)

Women riding their bicycles next to Nomboo orphanage in Koudougou.

Schorge Lycée in Koudougou, designed by Francis Kéré.

He defends the idea that the building should breathe, conversing with local climate, rather than being against it.[48] Thanks to the double roofs the indoor air enters through orifices or openings on the first roof and is swept by the wind circulating between both roofs. Equally, solar radiation heats the metal roof, but the underlying air is also dragged by this wind, so that radiation is not transmitted inside this building.

The indoor environment also benefits from the freshness provided by the earthen walls and is 6 to 8 °C lower than the exterior. This contrasts with the buildings with cement block walls and corrugated iron roofs which are the common alternative in the country. This solution leads to overheated and insalubrious environments

[48] **Ibid.**

Schorge Lycée in Koudougou.

which can only be remedied with the installation of air conditioning, an unsuitable option given its high installation and energy costs, which very few can afford.

In the last twenty years, Kéré has designed and built a primary school, a secondary school, teachers' housing, a library, wells, a vegetable garden, a kindergarten, and a women's centre in his hometown of Gando. All these projects have actively involved the residents, who have taken part in the decision-making and constructive processes for these buildings. However, this involvement may not have been as intense in his other work, as for instance in Opera Village, a project criticized for its eccentricity, the limited involvement of the population, the distant location, and the lack of public means of access.

Schorge Lycée in Koudougou.

Schorge Lycée in Koudougou.

Kéré's architecture takes inspiration from multiple points of reference, not just from the country's vernacular architecture. Nor does it take inspiration from African urbanism alone, as in the case of the plans for this Opera Village or Remdoogo, inspired by the kraal, a traditional settlement with a circular floor plan, slightly modified to become a spiral as a metaphor and strategy for future expansion. His extremely heterogeneous formal references are never literal, partly due to assimilation in the creative process itself, and partly due to the limited resources and budget, which constantly force him to come up with more cunning solutions making a virtue of necessity.

For instance, the undulating parasols of the extension of the school in Dano (2007) are reminiscent of the reinforced ceramic pergolas by Eladio Dieste, translated into sheet metal, just as the interiors of wavy vaults are reminiscent of his church in Atlántida. The size of these parasols is perhaps subconsciously just as reminiscent of Dieste's work as of the Zarzuela Hippodrome by Eduardo Torroja in Madrid.

With the bias-cut elliptical plan on the rectangular porch of the Gando library, Kéré shows his knowledge of Japanese architecture which, from Seiichi Shirai onwards, has frequently used this form, especially Tadao Ando and Toyo Ito. The fine metal trusses with a triangular section could almost have been inspired by the Tokyo Metropolitan Gymnasium by Fumihiko Maki, also with a corrugated iron roof, and lighting provided by the gaps in the shell, a resource often used by Kéré to provide lighting and ventilation to his vaults. A more recent reference, one of many, to the complex yet simple and lightweight metal trusses by Kéré are the latticed beams of

Village Opera in Laongo (Burkina Faso), designed by Francis Kéré.

Hamburg airport (1993) by Meinhard von Gerkan and Volkwin Marg, especially considering Kéré's German residence and training.

References to the work of Alvar Aalto are found in certain floor plan distributions, as well as in the palisade of round trunks of Lycée Schorge, which seems to have evolved from the Lapua Forest Pavilion (1938). Nods to German expressionist architecture are also frequent, both in the work of Hans Scharoun in the articulated caterpillar plan of the Lycée Schorge or the dwellings of Léo Doctor, and in that of Hugo Häring, especially the scattered location and the adoption of

School at Dano (Burkina Faso), designed by Francis Kéré.

random forms in the buildings with the upper roofs of Opera Village or the wind towers of Lycée Schorge, which seem to be the result of the automatic writing defended by this architect. It is also interesting to note Kéré's undeniable nod to the hyperboloid towers by Vladimir Shukhov in the water tanks of Lycée Schorge, which was undoubtedly the forced result of the need to use less material to ensure the greatest resistance possible, also guided by what could be defined as solid architectural culture.

The CRAterre Association

The CRAterre Association, set up in 1979 by Hugo Houben, Patrice Doat and Hubert Guillaud, has carried out important research on earthen construction. The constant work of dissemination, training and empowerment carried out by this institution may well be the reason for the increasing presence of earth in the cooperation projects carried out in Burkina Faso. These projects have led to the gradual recovery of the collective awareness of the value of earth as an appropriate and sustainable form of construction. In its over forty years of existence, this association has developed projects in more than thirty countries, especially in Africa, in Burkina Faso, Sudan, Egypt, Gambia, Tanzania, Senegal, Benin, Ivory Coast, Republic of Guinea, Mali, Algeria, Democratic Republic of Congo, Kenya, Ghana, Uganda, Togo, Morocco and Cape Verde.

Actions in Burkina Faso have included the conservation of the Na-Yiri (2003-2006) in Kokologho, a village 45 km from the capital Ouagadougou, consisting of its study, documentation, and revalorization, as well as the promotion of traditional trades linked to the maintenance of vernacular architecture. This Na-Yiri or palace residence of the *naaba* (chief) Kaongo, merging traditional culture with colonial influence, was built in 1942 by his father, the *naaba* Boulga. The complex is built of earthen adobe blocks rendered with earth mortar stabilized with *néré* juice. The

View of the courtyards created inside the Noomdo Orphanage (Koudougou), designed by Francis Kéré.

terraced roofs are built with African mahogany trunks, intercrossed branches and a thick layer of earth. The flooring is compacted laterite earth. The conical roofs of the circular huts, the pyramid-shaped roofs of the rectangular rooms and the porches to provide shade are built of 1x1.30 m braided straw panels which also act as doors, resting on the openings of the walls.

During the conservation process, at the suggestion of the *naaba* Kaongo, new constructive materials were incorporated into the earth renderings, with the addition of a percentage of asphalt, as well as into the mix used to compact the flooring, which was reinforced with a small amount of cement in the southern access to the official entrance courtyard and in the courtyard itself. This addition of new constructive materials is a preventive device to reduce the frequency of the need for maintenance, which traditionally guarantees the survival of trades while promoting social cohesion during the collective effort for repairs.[49]

[49] AAVV. 2005. *Le Na-yiri de Kokologho*. Grenoble: CRAterre-ENSAG; Kaboré, Barthélémy. 2009. *Le Na-yiri de Kokologho*, Joffroy, Thierry; Moriset, Sébastien (eds.). 2009. *10 ans d'experience de terrain. Projets situés*. Grenoble: CRAterre Éditions: 78-85; Napon, Abodulaye y Rakotomamonjy, Bakonirina. "The Na-Yiri of Kokologho", Joffroy, Thierry (ed.) 2005. *Traditional conservation practices in Africa*. Roma: ICCROM: 6-13.


Woman walking by the side of the road near Dano.

Project to improve the informal neighbourhood of Boassa carried out by the YAAM Solidarité association in partnership with CRAterre.

CRAterre has also worked towards reducing the vulnerability to floods of towns in Ouagadougou (2009-2010), with the reconstruction of the habitat of over 7,000 families affected by the floods of 1 September 2009. A training programme for 400 builders was set up to increase the protection of the foundations of the walls to be built in the capital. To do so, an intensive teaching programme of good practices in construction using earth adobe, particularly for foundations and the base of buildings, was set up.[50]

[50] http://www.craterre.org/action:projets (acc. 13/02/2021).

FARE Studio: Riccardo Vannucci and Giovanna Vicentini

Italian architects Riccardo Vanucci and Giovanna Vicentini and their studio, appropriately named FARE ("doing"), have developed, and continue to work on projects in different countries of the African continent including Burkina Faso, Chad, Madagascar, Mauritania and the Republic of Central Africa. This studio tries to incorporate all aspects of design into the local (cultural, social, economic, and environmental) context, resorting to the incorporation of traditional or improved materials such as CEBs for greater ease of maintenance.

They are the authors of the Women's Health Centre (2005-2008) in Ouagadougou in Burkina Faso, preselected for the Aga Khan Award in 2010. This building was commissioned by AIDOS, an Italian NGO fighting for women's rights in developing countries. The complex is made up of two blocks of buildings with shaded courtyards covered by tall PVC parasols which provide the climate control aimed for in the design. The double roof described in Kéré's work is also adopted in this case, a distinguishing feature of the building as it stands prominently over the first roof using tree-like pillars.

The maintenance issues in many of these buildings, caused by a lack of budget, attention, feeling of belonging in the community or all three factors combined, led to the FARE architecture studio drafting a manual with basic guidelines for the use and maintenance of the buildings in a good state of conservation, as well as environmental recommendations on the occasional installation of fans, air conditioning, separation of waste generated, etc.

Chiara Rigotti

Italian architect Chiara Rigotti, who has been working in Burkina Faso since 2002, explains the projects in which she has taken part referring to the need to build a healthy habitat, using durable local materials which do not waste energy, considering the cultures in which they are found. According to her this can only be attained by using the traditional techniques known to local master builders[51].

Rigotti has worked on programmes for the creation of local infrastructures designing schools, soup kitchens, gardens, composting centres, and renewable energy installations, as well as housing, hospitals, cinemas, and art galleries. In her work, Rigotti seeks to optimize existing resources, imposed by both necessity and her personal philosophy.

At the Research Centre for the Shea tree in Satiri, Bobo-Dioulasso (2015-2018), she created her own tile workshop to manufacture ceramic tiles for the building, a task which provided employment for local women while also promoting their social empowerment. In this centre, Rigotti applies cross ventilation between opposing façades in combination with an indoor courtyard with a pool which allows the air to be humidified and purified like wind catchers in Iran.

[51] "Un habitat sahélien sain et partagé: le rôle clé du maître d'œuvre", Chiara Rigotti, Bioarchirigotti, https://bioarchirigotti.wordpress.com/2018/10/29/un-habitat-sahelien-sain-et-partage/ (acc. 22/03/2020).

Construction of the Shea Research Centre in Satiri, Bobo-Dioulasso (Burkina Faso), designed by Chiara Rigotti.

Shea Research Centre in Satiri, Bobo-Dioulasso (Burkina Faso), designed by Chiara Rigotti.

The building is completely made of carved laterite blocks and bricks used for building both walls and Nubian vaults with a catenary profile. The lintels of the openings of doors and windows were finished with double-order segmental arches built with stretcher bonds. The use of reinforced concrete is always avoided, as is that of timber, which has limited durability due to xylophagous insects. In general, Rigotti resorts to the indigenization of constructive techniques such as the Nubian vault and natural climatization solutions such as Iranian wind catchers –in a context of

Manufacture of ceramic tiles for the centre.

Group of women working on the manufacture of ceramic tiles.

One of the domes of the Shea Research Centre in Satiri, Bobo-Dioulasso.

increasing desertification of the Sahel– which she puts into practice using local materials and labour.

Chiara Rigotti was also in charge of the conservation and renovation of the former headquarters of the Association for the Development of Traditional African Urbanism and Architecture (ADAUA) in the 1980s. This postmodernist building in the Sudanese style of the Sahel was built using CEBs and a characteristic language of vaults, domes, and interconnected rooms. It had been used as the Directorate for Cultural Heritage from 1990 to 1996, but since 1999 it has been the Georges Ouédraogo Museum of Music. This is an important commission as it shows the extent of the need for investment to adapt and maintain these buildings which were born from the spirit of the movement of Appropriate Technologies.

Albert Faus

Catalan architect Albert Faus (1972), who has been working and living in Burkina Faso since 2005, describes the initial difficulties in convincing clients and developers to accept the use of earth in their projects.[52] This reluctance was seemingly born from the association made between local and traditional and old-fashioned or poor, as a result of changes in forms of construction which had been taking place since colonial times. In general, new materials such as cement or metal sheets were appreciated for their definitive nature even if the construction was of poorer quality and less comfortable, while traditional adobe, rammed earth or CEBs were questioned as they were considered less durable despite being appropriate materials. At the same time, Faus admits the need to strike a balance by which adaptation to context, to project budget, and to the conditions of future maintenance yield the results of the best possible design for individual cases.

Among his work it is worth highlighting the shelter known as Home Kisito (2015) in Ouagadougou, an extension of a pre-existing building which was already devoted to this use. The new building has a reception, bedrooms, dining area, and associated services. A stone masonry wall acts as a protective screen against wind and storms, and beyond it the whole building is made up of CEB walls that are unrendered on the exterior, while the interior has a varnished wall with a traditional earthen finish. The flooring is compressed earth tiles treated with shea butter. The segmental arches of the roof rest on reinforced concrete sleepers and rings. Above it, profiles and simple metal enclosures support an upper roof in lacquered sheet metal. This upper roof provides ample shade to prevent overheating but also serves as a metaphor for the shelter provided to the children fostered. It also helps with the runoff of rainwater, relieving the CEB vaults of this responsibility, while the space between both

Entrance to Home Kisito orphanage in Ouagadougou, designed by Albert Faus.

[52] "Ser arquitecto en África: Albert Faus", *Del tirador a la ciudad*, *El País*, Anatxu Zabalbeascoa, https://elpais.com/elpais/2014/09/05/del_tirador_a_la_ciudad/1409896440_140989.html (acc. 26/03/2020).

Home Kisito orphanage in Ouagadougou.

roofs allows the air heated by solar radiation to be swept under the sheet metal and the air of the buildings to be refreshed.

In fact, the work of architects like Albert Faus or Chiara Rigotti in Burkina Faso is born of an in-depth knowledge of the conditions of the constructive process and of the adaptation suited to the function and resources available.

In a developing country where many of the tasks are still manual, the human effort needed for the construction of the building is yet another factor to be taken into consideration from the design phases onwards, and this requires thinking from the perspective not only of the building's users, but of its builders.

Ophtalmological block in Boulmiougou (Ouagadougou), designed by Albert Faus.

In keeping with the work carried out by CRAterre the architect Albert Faus proposes working on the conservation of architectural heritage to reclaim local culture. Using funding from the Official College of Architects of Catalonia (COAC) through its cooperation grants, in 2018 Faus organized a seminar with the women from the village of Tangassogo to recover traditional earthen renderings in the group of dwellings belonging to one of the families. This project was also the subject of a photography exhibition, *Per Durar*, held in Barcelona at the Museum of Granollers and in the College of Architects of Catalonia. The selection of images was used to valorize and promote the typical constructive traditions of this region of Burkina Faso, focusing on the role of women, who were traditionally in charge of rendering constructions, in this conservation project.[53] This project was also reflected in the documentary *Tangassogo. Cuidem la casa.*[54]

La Vôute Nubienne Association

These solutions adapted to the context, promoted by cooperation projects, have been partially adapted to the self-construction of dwellings in Burkina Faso. Houses generally maintain the traditional configuration but use cement and, especially, corrugated iron for building roofs. These materials are still preferred as a sign of modernity and progress. As in most cases the lack of economic and technical resources prevents the application of the double roof solution introduced by cooperation projects, which could combat precarious and uncomfortable domestic interiors.

It is also worth mentioning the establishment in 2000 of the Association *La Voûte Nubienne* by French builder Thomas Granier and Burkinabe farmer Séri Youlou. This association specializes in the construction of roofs using the ancient technique of Nubian vaults as a sustainable option which is more suitable than sheet metal roofs. This solution, based on the use of earth

One of the rooms of the ophtalmological block in Boulmiougou (Ouagadougou).

[53] "La restauración del poblado de Tangassogo, financiada con el apoyo del COAC, protagonista de una exposición", COAC, Colegio Oficial de Arquitectos de Cataluña, 2020, https://www.arquitectes.cat/es/la-restauraci%C3%B3n-del-poblado-de-tangassogo-financiada-con-el-apoyo-del-coac-protagonista-de-una (acc. 09/03/2021).

[54] "Tangassogo. Cuidem la casa", COAC, Colegio Oficial de Arquitectos de Cataluña, 2019, https://www.arquitectes.cat/ca/arquitectura/actes/projeccio-debat-documental-cooperacio-tangassogo-burkina-faso (acc. 09/03/2021).

to manufacture sun-dried adobe and mortar is also presented as an alternative to the scarcity of timber resulting from desertification of the country. This is therefore a cooperation task more geared towards the improvement of housing rather than the public facilities usually prioritized in international cooperation.[55]

The general work procedure of this association is as follows. Buildings are almost exclusively earth, except for the stone masonry foundations.[56] The walls and roofs made up of vaults or domes are built using earth adobe, termite mound material or occasionally CEBs stabilized with cement. The vaults are always self-supporting so that they require no centring or formwork for their construction. The vaults reach a maximum span of 3.25 m, while there is no limit to their length. The builders establish the outline using a cord as a compass and can build a first floor as well as a ground floor.

Depending on their role in construction, walls have a standard thickness (80 cm for the dome load-bearing walls, 60 cm for the vault load-bearing walls and 40 cm for party walls), while measurements for doors, windows, etc are also regulated. A bituminous product is added to finishing earth mortars in order to further guarantee watertightness and reduce maintenance needs to ten-year intervals. If the bituminous product is not added, the finishing earth rendering requires annual maintenance.

Labour costs account for almost all of the constructive costs so that in addition to avoiding the use of timber in locations that are generally deforested, it is also logical to use these techniques in developing countries. In addition, the almost exclusive use of earth for walls and roofs is not only a kilometre zero solution but it also reduces costs as there is no need to acquire or import materials, translating into well-ventilated and climatized interiors, unlike the dwellings which directly adopt corrugated iron, with no underlying ventilation.

This association is currently active in five countries of the Sahel (Burkina Faso, Mali, Senegal, Benin, and Ghana), where it has developed a programme based on the dissemination of the concept and advantages of Nubian vaults, training in the technique, the transfer of ownership to local stakeholders, and national and international support. In twenty years of existence, it has built over 2,000 dwellings and other structures, favouring the participation of the community in construction. The work of this association has gained international recognition with different awards, including the Ashoka Changemakers Innovation Award for Affordable Housing (2006), the Tech Award for Economic Development (2007), the Seed UNEP Award (2011), the Award of the Schwab Foundation for Social Entrepreneurship of the Year for Africa (2012) and the UN-Habitat International Award for Best Practices (2013).

[55] Association La Vôute Nubienne – http://www.lavoutenubienne.org/en/nv-technique (acc. 29/01/2021).

[56] Paulus, Jehanne. 2015. Construction en terre crue. *Dispositions qualitatives, constructives et architecturales. Application à un cas pratique: Ouagadougou*. Université de Liège – Faculté des Sciences Appliquées: 77-79.

Repairing dwellings during the Boassa neighbourhood improvement project.

Cooperation in urban development projects

There are other cooperation projects focusing on the demand for housing and habitability conditions in the capital of Burkina Faso. From 1978 until the late 1990s, urbanist Coen Beeker from the University of Amsterdam carried out a series of projects for the restructuring of spontaneous settlements in the city of Ouagadougou. These projects followed a participatory approach within the community and aimed to integrate self-builds into the city's urban layout and provide them with basic services. These actions fell under the category of theories of participatory urbanism, accepted in Europe from the mid 1960s, and that of approaches for sustainable autonomous development, characteristic of the 1970s. Other points of reference for this initiative include that of John F. C. Turner, who defended small-scale self-builds within the framework of infrastructures provided by the large-scale administration.[57]

In keeping with these actions, we find the recent example of the Participatory project for the improvement of the informal neighbourhood of Boassa in Burkina Faso, carried out by the local association *YAAM Solidarité*, funded by the Abbé Pierre Foundation with the technical support of the French institution CRAterre.[58]

This is a collective initiative for organizing neighbours and involving them in the improvement of their habitat, raising awareness of their capacity to cover their own needs. The objectives of this project include:

1. Integrating the informal district into urban planning.
2. Reducing the precarious nature of the dwelling through the creation of a rotating fund and an aid plan in construction.
3. Facilitating the restructuring of the urban fabric.
4. Providing local inhabitants with the necessary tools for the improvement of their surroundings and the way of life.

Participatory activities for the improvement of the neighbourhood..

5. Supporting different neighbourhood associations and the activities which generate their income.
6. Encouraging collaboration dynamics on a regional and national scale.

Conservation and valorization projects

This section highlights the major undertaking of the CRAterre group, both in Burkina Faso and Africa, through projects, actions, construction, training, and different publications aiming to awaken the social awareness of residents of tangible and intangible heritage. For instance, it is worth mentioning the guide for African governments Cultural Heritage & local development, which aims to prove the economic importance of the care, maintenance and conservation of architectural, archaeological, and intangible heritage which can become a driving force for

[57] Turner, John F.C., Richter, R. 1972. *Freedom to build*. New York: The MacMillan Company; Tur, John F.C. 1977. *Housing for People. Towards Autonomy in Building Environments*. New York: Pantheon Books.

[58] Tom Ouédraogo, *Boassa un avenir por les nons lotis: Une iniciative collective à Boassa, avec l'Association Yaam Solidarité*, So Plane Productions, Ouagadougou, 2019

Construction of buildings during the Boassa neighbourhood improvement project.

development.[59] In Burkina Faso, despite the existence of Ordinance 85-049 / CNR-PRES of 29 August 1985 on the protection of cultural heritage, this continuous task of raising social awareness is still necessary, as in many other countries.

In addition to the projects listed for every cooperation architect named, there are specific initiatives for the conservation of monumental, historic, or vernacular heritage worthy of mention. These include the cooperation work carried out in Kassena villages such as Tiébélé, featured in the tentative list of UNESCO World Heritage Sites, for its recovery and the maintenance of the trade of decoration of dwellings in the hands of local women.

59 Barillet, Christian, Joffroy, Thierry, Longuet, Isabelle (eds.). 2006. *Cultural heritage & local development. A guide for African local governments*. Grenoble: CRATerre-ENSAG / Convention France-UNESCO

Making traditional earthen rendering in the Boassa neighbourhood.

In 2008 CRAterre worked on the study, documentation, awareness, maintenance and valorization of the buildings of the Royal Court of Tiébélé.[60] A similar study and conservation experience was carried out in Tiébélé around 2012 by the professors Hugues Wilquin, Alain Sabbe, Laurent Debailleux and the student Charlène Choumil from the Université de Mons. These actions identified the physical as well as the social issues of the constructions which

[60] AAVV. 2008. *La cour royale de Tiébélé. Burkina Faso*. Grenoble: CRAterre-ENSAG; Joffroy, Thierry Moriset, Sébastien (eds.). 2009. “Tiébélé”. *10 ans d’experience de terrain. Projets situés*. Grenoble: CRAterre Éditions: 144; Barillet, Christian, Joffroy, Thierry, Longuet, Isabelle (eds.). 2006. *Cultural heritage & local development. A guide for African local governments*. Grenoble: CRATerre-ENSAG / Convention France-UNESCO: 92d

Student at Baasneere school.

lay behind the progressive abandonment of maintenance. In 2015- 2016 a group of Japanese researchers, including Miku Ito from Seinan Gakuin University in Fukuoka, Takao Shimizu from Kyoto Seika University and Hirohide Kobayashi and Seiji Nakao from Kyoto University, analysed the transformation process of constructive techniques and the extensions of the dwellings of the village of Alampoa, as a tool for knowledge to try and conserve the essence of its traditional architecture.[61] Moreover, as mentioned earlier, in 2018 the architect Albert Faus took part in the conservation of the Allou-Sana concession in the town of Tangassogo with cooperation funding from the Official College of Architects of Catalonia, an experience which was eventually recorded in the exhibition *Per durar*.

Taking advantage of the former artisan foundry kilns of Tiwêga, near Kaya, and some time before they were listed as UNESCO World Heritage Site, the Cultural Association Passaté, a local NGO founded in 2001 for the safeguarding of oral tradition, art and crafts, created a museum of African kilns reproducing old foundry kilns from localities such as Sanmatenga, Houet, Passoré, Noumbiel and Namentenga in Burkina Faso and other countries such as Ivory Coast, Niger and Mali. This local initiative has taken shape thanks to the grants received from the Prince Claus Fund for Culture and Development, a Dutch foundation promoting the defence of culture in developing countries. This example of the valorization of the trade of paleo metallurgy, an account of the technology of humanity present and active in Burkina Faso for the last three thousand years, has not only drawn attention to its conservation but has also indirectly contributed to these kilns in Burkina Faso being declared a World Heritage Site.

Algemesí Solidari in the village of Baasneere

The actions of the NGO Algemesí Solidari in Baasneere are inserted in this context of cooperation architecture. As will be explained in the chapter on this association, the action of Algemesí Solidari, collaborating with its Burkinabe counterpart A3B, began with the construction of a well in the Basnekoudougou neighbourhood (2011) requested by a group of local women. From then on, the relationships between both towns became closer, organizing a work cap for the construction of the well, with a later twinning between Algemesí (Spain) and Baasneere (Burkina Faso) (2012) and a second work camp to rehabilitate the Health Centre (2013). A series of short documentaries on life in Baasneere was also made and presented in Algemesí. Ever since, volunteers from both associations have organized summer camps for the children of Baasneere (2014) and successive stays to supervise the development and construction of a secondary school (2015-2018).

This project for *L'Escola de Baasneere* was born from popular demand for this type of school, and concern on how to build these needed buildings

[61] Kobayashi, H., Shimizu, T., Ito, M., Nakao, S. 2018. "Transforming Kasena houses and indigenous building technology in Burkina Faso"; Shimizu, T., Nakao, S., Kobayashi, H., Ito, M. 2018. "Transformation in the Kasena's large earthen compound houses in Burkina Faso". Mileto, C., Vegas, F., García-Soriano, L., Cristini, V. 2018. *Vernacular and Earthen Architecture*. London: CRC Press: 147- 152, 343-348.

Volunteers from Algemesí Solidari during the second phase of the construction of the project.

Classroom building of Baasneere school, built during the first phase of the project.

suitably. From the beginning the Project referred to the path initiated by Francis Kéré with his first project for the Primary School in Gando (2001) and followed since then by architects Albert Faus and Chiara Rigotti, as described above. Therefore, the design and construction of the school has also aimed to follow this architectural trend born of cooperation projects which try to connect to the place in which they are built through the materials.

Within this project the chance came up for collaboration between the Universitat Politècnica de València (UPV), through the *Res-Arquitectura* group, and the NGO Algemesí Solidari. As will be seen, this UPV project was set up to provide support to the Baasneere school project through research. Architecture has the virtue of reflecting ideals and aspirations shared by the society that constructs it. After the recent history of Burkina Faso, however, this capacity for communication began to be lost with the introduction of other foreign languages. Therefore, the main shared objective for projects commissioned in the country, and especially for international cooperation projects, should be to leave space for the recovery of local expression in order to restore continuity between the modern architecture and traditional constructive culture. Thus, the WithBurkina project shares this common aim, a task which has already begun, and which has been described in this chapter.

PART 2. THE ARCHITECTURE OF BURKINA FASO

Below is an account of the architecture of Burkina Faso analysed from different perspectives, based on the observations derived from our experience in many parts of the country, and on the architecture of some different ethnic groups, as sometimes described in the existing bibliography on the subject. It is impossible to write a complete and exhaustive treatise, or at least too complicated to summarize it in these few pages. There is a series of limitations to be taken into account: the impossibility of visiting every last corner of the country, the existence of different subgroups in different ethnic groups (such as the Senufo, Nuna, Bobo, etc.), appearing here under a single epigraph despite slight differences between them. Other factors include the presence of architectural and constructive variants within the same ethnic group or subgroup; the phenomenon of multiculturalism in cities as well as by roadsides and in the countryside; the appearance of new constructive techniques and materials homogenizing vernacular architecture throughout the country; the existence of seemingly absent or elusive organizational strategies which are invisible to the outside observer; and the recent influences affecting different ethnic groups. Despite the above, this challenge has been undertaken aiming as far as possible to contribute using knowledge acquired in a large part of the country.

Birifor habitat. Natural lakes around Navièlgane.

3. Habitats

A habitat is a setting or series of physical and geographical factors, such as location, climate, form, etc. which surround a specific ethnic group. While it is not possible to generalize, habitats do also tend to incorporate the culture and way of thinking of ethnic groups and inhabitants. The habitat in the vast plains of the Burkina Faso savanna displays very gradual changes. The northern region borders with the Sahel while in the southern region the steeper terrain and heavier rains directly affect the fertility of the soil, types of cultivation, and density of the trees, producing a landscape that is more enclosed. Below is a brief description of the habitats which gave rise to the architectural cultures of the Birifor, Bobo, Dogon, Gan, Kassena, Ko, Lela, Lobi, Mossi, Nuna, Peul, Puguli, Senufo and Tuareg.

Birifor Habitat

The Birifor live in the south of Burkina Faso, in the open grasslands of the African savanna which gradually becomes more wooded with scattered trees and thickets. Their subsistence farming (rice, millet, peanuts), depends mostly on the regular rainy season, and they keep farm animals such as livestock and chickens. If possible, they settle close to lakes, lagoons, and natural ponds in order to be able to fish, sometimes hunting and collecting wild fruit to complement their diet. This leads to the creation of compact settlements in the form of small fortresses where the extended family lives, seeking protection from an exterior which –as shown by its configuration– has traditionally been hostile. Once a certain point is reached, the sons can leave the family home with their wives and children to set up one of their own. The Birifor have an exchange economy, with markets held every five days where up until recently cowrie shells were used as currency.

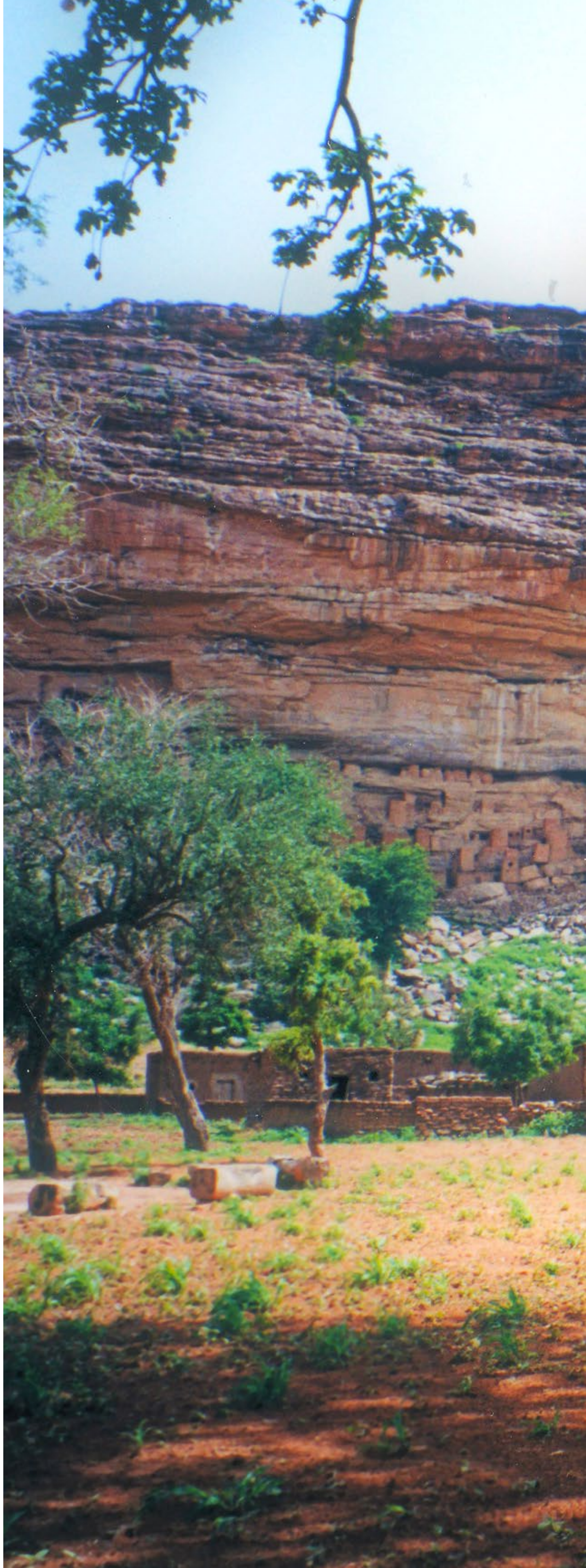
New Bobo habitat. Cultivated plains dotted with forests.

Bobo Habitat

No longer dominated by the Mossi, the Bobo population has settled around the major capital Bobo-Dioulasso as well as in surrounding towns and villages. These decentralized communities enjoy a high level of autonomy and are not controlled by a single person or hierarchy. However, the Bobo ethnic group remained fiercely united due to the local cooperative labour systems of its communities up until the establishment of the French colony. The habitat in the southwest of Burkina Faso tends to be flatter and greener than in that of the rest of the country and millet, sorghum, peanuts and even tomatoes are grown there, while the livestock have grazing, at least during the rainy season.

Dogon Habitat

The Dogon habitat is located around the lower plateau, foothills and lower plains of the Cliff of Bandiagara.[62] The Land of the Dogons around the Cliff of Bandiagara, in the neighbouring country of Mali, has been declared UNESCO World Heritage for its surroundings, landscape, architecture and traditional culture. However, the Land of the Dogons extends down the lower plain and the cliff ridge to the west of Burkina Faso, where 5% of the Dogon people live. The Dogons are therefore one of dozens of ethnic groups living in Burkina Faso, although the distance from the main hub of culture, along the Cliff of Bandiagara, is certain to have tempered its most unique characteristics. The village of Gani in Burkina is in the province of Kossi, in the department of Kombori-Koura, 110 km from Nouna and bordering with Mali. Its stone dwellings at an altitude of over 100 m on a hill are a reminder of the original inhabitants who settled there over 600 years ago. The anthropomorphic disposition of Dogon settlements determines that the head, usually oriented to the north, is the location of the blacksmith and the toguna or communal meeting place; this body hosts most of the dwellings; the houses for menstruating women are located in the hands; the navel is the position for the male altar and the female oil mortar, while the sanctuary is located at the feet[63]. In fact, this configuration is hard to make out at first glance in the villages in Burkina which have been more orthodox in following tradition, and it has been impossible to confirm its existence in the Dogon villages, where it is even less clear.

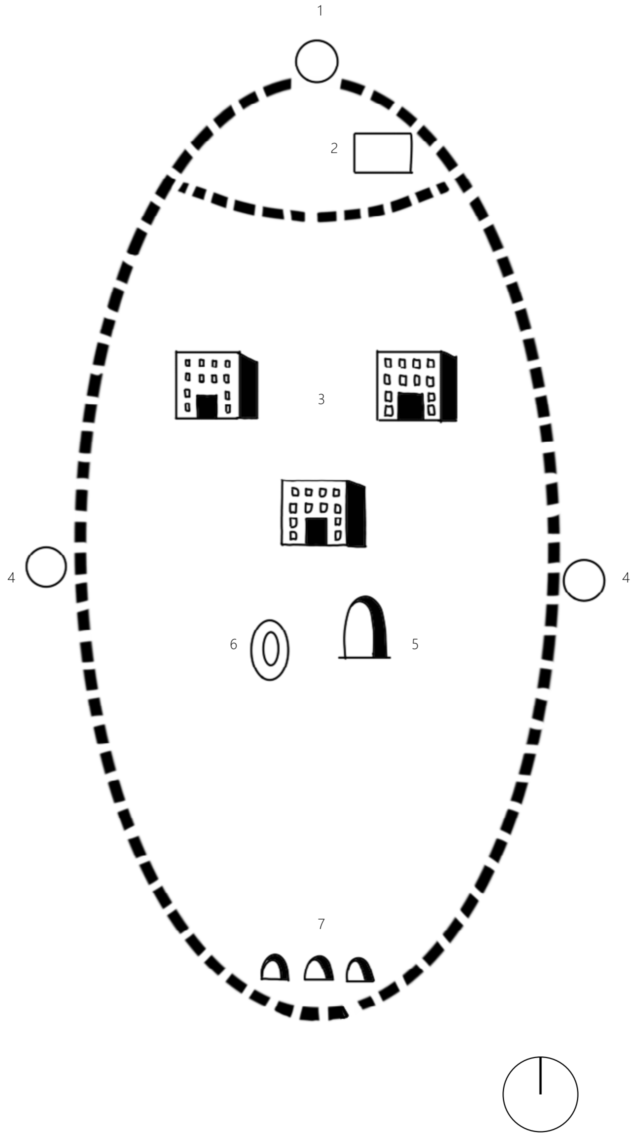


[62] Huet, Jean-Christophe. 1994. *Villages perches des Dogon du Mali. Habitat, espace et société*. Paris: L'Harmattan; Guidoni, Enrico. 1975. *Architettura primitiva*. Milán: Electa; Guidoni, Enrico. 1975. *Architettura primitiva*. Milán: Electa: 138-161.

[63] Griaule, Marcel [1966] 1987. *Dios del agua*. Barcelona: Alta Fulla; Guidoni 1975, op.cit.: 13.

Dogon habitat. The main settlements of the Dogon are located around the Cliff of Bandiagara (Mali).

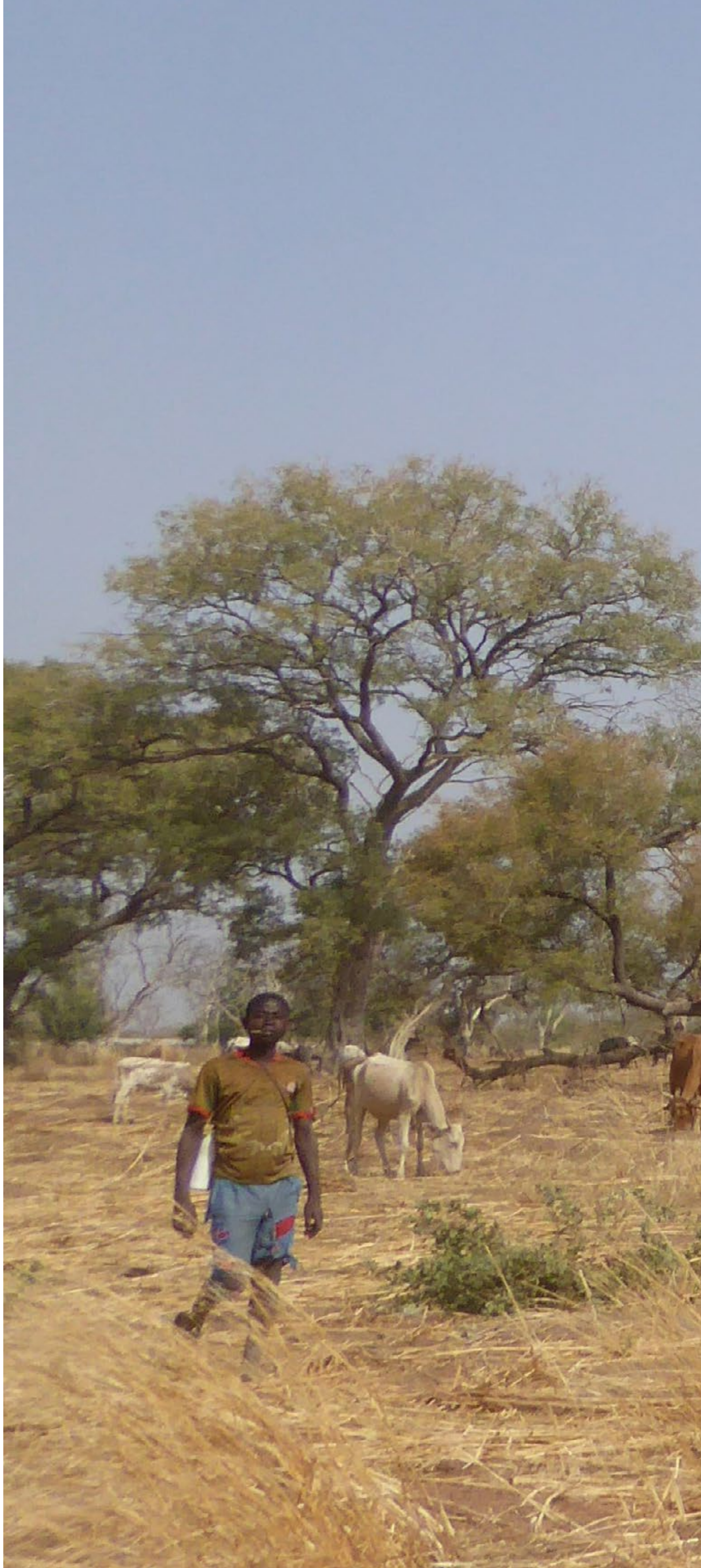
Dogon habitat. Savanna stretching towards the south from the Cliff of Bandiagara to the hill of the department of Kombori-Koura, also home to the Bobo ethnic group settlements in Burkina Faso.



Dogon habitat. Anthropomorphic layout of Dogon settlements, redrawn following the diagram designed by Marcel Griaule. Legend: 1: Forge (head). 2: Square. 3: Dwellings (chest). 4. Menstruation house (hand). 5: Village altar (male sex). 6: Oil stone (female sex). 7: Altars (feet).

Gan Habitat

The Gan are a subgroup of the Lobi ethnic group in the southwest of the country. Unlike many other groups in the region, the Gan have preserved their traditional system of government which is based on royal lineage. Although there is still a king, he reigns in name only over the spiritual and worldly aspects of the Gan villages beside the Ruins of Loropeni. This impressive wall of an ancient fort, almost a thousand years old and spread out over a hectare, was built by other ethnic groups. The Gan are agricultural and farm workers in a characteristically flat landscape with an abundance of seasonal rain, typical of the south of the country. This allows them to grow tubers requiring water, such as tiger nuts, which they are able to trade. Other crops include their basic millet crop, and their diet is complemented with beans, corn, yam, tomatoes and vegetables. Their villages in the forest glades are made up of scattered dwellings in the form of freestanding circular huts with occasional covered porches or silos, chicken coops in the form of small huts, and log pens. The villages are made up of scattered circular huts set out close together but sometimes interspersed with family silos. Between the huts there are meeting spaces with shelters used for shade, cooking, or storing wood or straw for roofs. In these spaces trees grow, chickens roam free, pigs root, goats roam or children play supervised by adults. In the outskirts of each village there are chicken coops, pigsties, yards and other huts for animals, smaller versions of the village huts.



Gan habitat. Pasture area around the Ruins of Loropeni.

Gan habitat. Woman beside an animal yard outside the Obiré settlement.

Kassena habitat. Nazinon or Red Volta River passing through the Kaboré Tambi National Park.

Kassena Habitat

The Kassena are settled in the centre-south region of the country, on the border with Ghana, where 60% of their population lives. This is an area of plains with some gently sloping hills. As in the rest of the country, the heat is intense, but due to the heavy rainfall from the rainy season there are trees and semi-wooded areas, less frequently found in the more northern parts of the country. Trees are therefore part of the landscape immediately surrounding the villages and natural ponds are quite common. The villages are located on the plains and their single-storey homes and respective enclosures are grouped together to form a compact whole, probably for defensive purposes, with very few scattered buildings around. In the dry season, they look

Kassena habitat. Natural lake near Tiébélé.

beyond the surrounding fallow land in search of more distant horizons for hunting or lakes for fishing. This closed, compact and introspective nature of the Kassena villages, so different from that of the scattered Lobi villages, can be understood as the interpretation of public and private space of the Kassena culture. In Kassena culture, interior spaces, even thoroughfares, courtyards, etc. gradually shift from semi-public to semi-private before reaching the huts, which are completely private. The only truly public space is the space outside the settlement.[64]

[64] CRAterre-ENSAG. 2014. *L'Architecture des Kassena. Une expression des espaces au féminin*, https://craterre.hypotheses.org/86, (acc. 22/11/2021).

Kassena habitat. Kassena settlement in the middle of crop fields surrounded by ceiba and baobab trees.

Kassen a habitat. Women working on their houses.

This also contributes to the closed and inclusive nature of this ethnic group, and is reflected in the architecture of their settlements.

Ko Habitat

The Ko are a subgroup of the Gurunsi ethnic group and live in the province of Mouhoun, in the centre of Burkina Faso, on a vast savanna platform gradually sloping down to the south. The climate is dry most of the year and the land is barely fertile. Their economy, which is dependent on subsistence agriculture, includes millet, yam, peanut, rice and beans. In domestic vegetable gardens the women grow okra, onion, tomatoes and red peppers. Their diet is complemented with the products from farm animals, wild fruits, fishing and hunting. As their surroundings are exposed and they are much fewer in number than other predominant peoples, their form is that of a compact group and extended family defending itself from enemies, wild animals and even witches. This concept is also reflected in the compact architecture of the settlements.

Gurunsi habitat. The Gurunsi ethnic group, which includes groups such as the Ko, Lela, Nuna and Sissala, is found near natural water sources throughout the south and centre of Burkina Faso.

Elephant at Nazinga.

Lela Habitat

The Lela live to the west of the capital Ouagadougou, near the city of Reo. This dry savanna area has an unpredictable rainy season from late May to late September, like the rest of the country's savanna region. The landscape of its vast plains thus changes radically throughout the year, going from the stifling yellowish aridity of the dry season to fresh green herbaceous vegetation and leafy trees in the rainy season. Scattered settlements spring up in the clearings of the existing trees. In the dry season the Lela use the sand to read their divinations from the tracks of passing animals.[65]

Lobi Habitat

This habitat is located in the south of the country, around the city of Gaoua. The Lobi are traditionally a warrior people, proud of their strong identity, although they lack a centralized political authority. They are not keen on interference from the outside world. The villages appear here and there. Their dwellings are spaced out and scattered on the landscape but as the villages spread out they may appear to be so close to each other that it becomes difficult to distinguish their perimeter, division or even their name.

Lobi habitat. Family dwellings with extensions scattered across a hilly landscape dotted with vegetation.

[65] Cartry, M. 2005. "Une écriture divinatoire/Eine Orakelschrift". In Baur, R. (ed.). *La Loi et ses consequences visuelles / Das Gesetz und seine visuellen Folgen*. Leipzig: Lars Müller Publishers: 402-429; Pecquet, Luc. 2014. "Un interdit des maçons lyela et sa transgression (Burkina Faso)". *Comparer les systems de pensée. Systèmes de pensée en Afrique noire* n. 19: 117-145

Lobi habitat. Burning of straw and stubble in December and January for use as fertilizer for the crop fields.

The reason why their *sukalas* or fort dwellings are so dispersed is that tradition dictates that the distance between homes must be at least that of the flight of an arrow. In this case, each household in the village has the individual responsibility of defending themselves. The surrounding landscape is characteristically flat, with occasional soft rolling hills scattered with trees which grow thanks to the heavy rainfall of the rainy season in the south of the country.

The clear separation of roles of the Lobi ethnic group is reflected not only in social organization, but also in the architectural space and rhythm of its use. Men are in charge of clearing and preparing the crop fields while the women are in charge of sowing and harvesting. Men take care of livestock, and occasionally hunt, while women pick fruit, stock up on water and wood, and cook. Within the home, men have their spaces and each wife has her own room for her and

Mossi habitat. Nazinon or Red Volta River passing through the province of Boulkiemdé.

her children, where she even prepares her food. The animism they practise is a response to their respect for and communion with surrounding nature, so much so that hunters beg forgiveness for the animals they are going to hunt for food. The use of the dwelling, fields, pens, silos and other auxiliary constructions is a response to this division of labour by gender.

Mossi habitat

The Mossi are currently the most numerous, powerful and widespread group in Burkina Faso. They are mostly found in the savanna of the central mountain range of the country, around the capital Ouagadougou. Based in this savanna, they have traditionally traded between the desert areas of the Sahel and the greener regions of the south. The alternation between

Mossi habitat. Nakambe or White Volta River passing through the province of Sanmatenga.

the dry season and the three months of intense rain noticeably modifies the landscape in a very short time. In June, July and August the surface is filled with freshly sprouting plants. Subsequently, the intense sun soon makes this greenery die down, eventually causing the earth to dry and crack. In February there is a strong harmattan wind, which comes loaded with sand from the Sahara. The space previously occupied by vegetation appears empty, barren and exposed, with only a few scattered trees. In the past, the vast plains which spread over the country favoured the creation of a centralized state and a single hierarchical political system among the ethnic groups of Burkina Faso. Officially, there is currently a monarchy with a king who rules and influences these peoples, although he has now lost all political power.

Mossi habitat. Gathering wood for fuel in the tree-dotted savanna.

These settlements spring up and spread around markets and crossroads and along roads. The different neighbourhoods, usually spread out, tend to be defined by the professional specialization of each clan.

Mossi habitat. Women cycling along paths.

Donkeys in the vicinity of Kaya.

Nuna habitat. Nuna settlement in a natural setting of tree-dotted plains.

Nuna habitat

The Nuna or Nunuma are a subgroup of the Gurunsi ethnic group, settled in the southern region of Burkina Faso, around the city of Leo, a few kilometres from the Ghana border. They are generally subsistence farmers in the African savanna characteristic of much of the country. They take advantage of the rainy season to grow millet, corn, sorghum, peanuts, yams, and occasionally cotton, which they sell. With a language of their own, Nuni, they are famous for their crafts: the production of polychrome masks in red, white and black; the small statues carved in wood and mud; wooden stools; and jewellery, which is usually connected with honouring their ancestors.

Peul habitat. Small Peul hut on the outskirts of the province of Sanmatenga.

Peul habitat

The Peul people are distributed throughout Mali, Guinea, Cameroon, Senegal, Niger, Guinea-Bissau, Benin and Burkina Faso, although some are also found in regions of Ghana, Mauritania, Sierra Leone, Togo and Chad. In Burkina Faso, the traditional habitat of the Peul, a nomadic shepherding people, is the open savanna landscape, where they build their plant huts, which are then moved to suit the needs for foraging and water of their livestock. This can include cows, oxen, goats, sheep… even camels, which are sometimes used as beasts of burden.[66] In dry seasons, the herds are moved to wetlands and flooded areas in search of suitable pastures. In the wet season they occasionally cultivate edible plants. They mainly live in the north and east of the country. Many Peul have abandoned nomadism –either totally or partially– and have settled in the periphery of Mossi settlements, always linked in some way to pastoralism making use of the open landscape around them. The geographic horizon of the Peul ethnic group is much vaster and more widespread, even psychologically, than that of other sedentary peoples.

Puguli Habitat

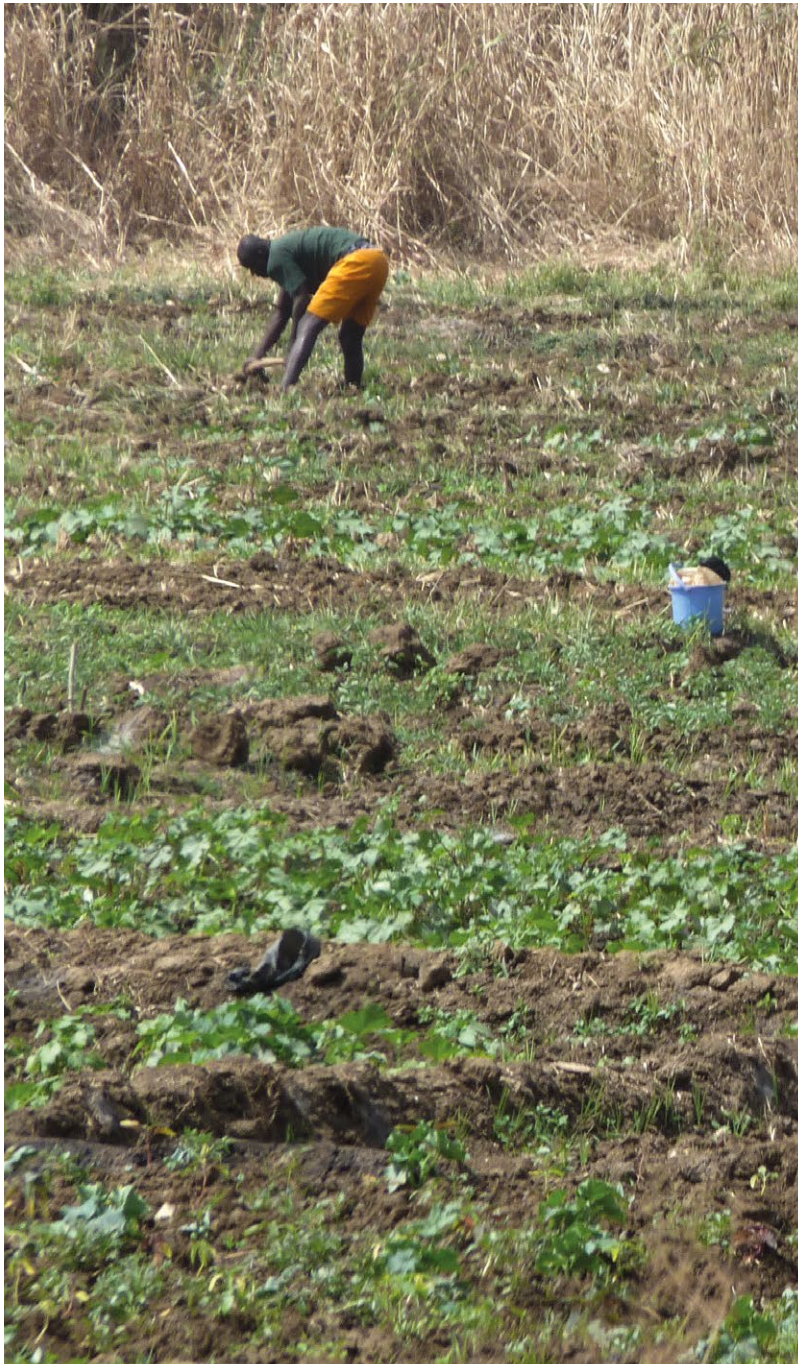
The Puguli live in regions to the north and west of the city of Diébougou, in a savanna which gradually becomes more wooded in the southern parts of the country. Their economy is based on the cultivation of millet, yams, peanuts, rice and beans, with vegetable patches where they grow okra, onions, tomatoes and peppers. Their livestock includes cattle, sheep, goats, pigs and chickens and they also hunt and fish and collect wild fruit. The Puguli villages are made up of various

[66] Beaudoin, Gérard. 1998. *Soudan occidental. Histoire et architecture*. Paris: BDT Éditions: 16-20.

concessions or extended dwellings, whose proximity is determined by the closeness to the paternal relationship and separated by narrow alleys. The villages, clustered as protection from wild animals and witches, can have from 200 to 3,000 inhabitants.

Senufo habitat

The Senufo ethnic group is currently spread out over the Ivory Coast, Mali and Burkina Faso. In Burkina Faso, they occupy the southwest of the country, in a characteristically hilly area of the Middle Volta region. They live in small villages with 50 to 2,000 inhabitants, and have a strong sense of community, both for the individual settlement and the Senufo ethnic group in general. This has contributed to the careful conservation of their traditional art, sculpture and music, especially the musical traditions of the balafon, a percussion instrument which has been declared UNESCO Intangible Heritage. Agriculture is a group activity and the produce is collectively stored. The grasslands of the region are mainly used to cultivate rice, sweet potato, peanuts and millet, as the rainfall is heavier here than in the rest of the country. This area is also more densely wooded than other Sahel areas in the country.



Senufo habitat. Men working in the crop fields.

Tuareg Habitat

For centuries the nomadic Tuareg people have lived in and travelled through a geographical habitat which extends throughout the Sahara desert. The current geopolitical division of Burkina Faso is only part of this much wider territory. The Tuareg form extended family units descending from a single ancestor who is recognized as a common link and are herders on a large scale. Their economy is fundamentally based on camel breeding and caravan trade. When settled in one space for long enough the Tuareg also farm the land with their slaves. Women have authority in the camps as men are frequently away working as herders, traders or, in the past, warriors. As with the Peul the geographical horizon of the Tuareg is much larger and more widespread, both in physical and psychological terms, than that of other sedentary peoples.

Senufo habitat. Camels have become working animals even in areas far from Tuareg habitats.

Bunches of straw grown for use in construction and piled up near Coumpougoubié, in Nahouri province.

4. Materials

The construction of traditional architecture uses very few basic materials: earth, straw, timber, and ceramic. More recently, different types of modern materials such as cement, metal in various formats, bituminous products and glass have been introduced and their use is now widespread.

Earth

Earthen walls built with different techniques are the main construction element of vernacular architecture in the country.[67] Generally, for construction the earth extracted from the soil is cleaned to remove organic remains and larger stones. It is then mixed with water or, if the soil is very clayey, with straw and sand. Once the earth has been mixed different techniques –depending on the individual constructive cultures– are used to build earthen walls. Earth in Burkina Faso comes in different geological forms, making it possible to dig out hard lateritic cut blocks for use in construction. Earth is also used to channel runoffs and delimit cultivation fields, as well as to build platforms, benches, stairs, vaults, domes or flat roofs and to produce mortar to render adobe, laterite and very occasionally stone masonry constructions.

[67] Mumtaz 1978, op.cit.: 90.

Preparing the earth to make adobes.

Manufacturing adobe, one of the constructive materials currently used in rural areas of Burkina Faso.

Adobe laid out in different ways to dry in the wind and sun.

The earth from termite nests, made by the termites using a mix of earth, saliva and cellulose, is occasionally employed in the construction of cob walls which are particularly resistant to the elements.

Local production of compressed earth blocks or CEBs in Ouagadougou.

Compressed earth blocks used in the construction of Opera Village, designed by Francis Kéré.

Quarry for the extraction of lateritic cut blocks or BTL.

Stacked lateritic cut blocks ready for use in construction.

Kassena women using their feet to mix the clay for maintenance tasks.

The straw from different plants, and to a lesser extent, common and giant reeds, are other materials more frequently used for the construction of traditional architecture in Burkina Faso, in the form of mats, roofs, panels, blinds, etc.

Straw

The straw used to build mats in the traditional architecture of Burkina Faso is usually from the Andropogon genus of the grass family (Poaceae). These perennial caespitose plants with a soft brome head can grow to a height of 3 metres. These mats are hung vertically to create enclosures, placed horizontally to provide shade or shelter from the rain, or as receptacles to build grain stores. Although less common, there are many examples of mats made up of giant reeds (*Arundo donax*) or common reeds (*Phragmites australis*) placed

Transporting a bundle of dry Pennisetum purpureum or elephant grass by bicycle for use in the production of mats.

Weaving elephant grass to make mats.

Rough rounded logs used as joists close together to withstand the weight of the thick layer of earth forming the flat roof of a bobo dwelling.

parallel and bound with straw strips. Straw from these and other species are used to build the conical roofs which crown the circular huts and grain stores, while thatched hoods cover the grain stores, and straw panels are used for doors, gates, and occasionally shacks with gable roofs. In addition, pieces of straw from the cereals grown for consumption are mixed with earth to prevent cracks appearing from retraction during the drying process.

Timber

Timber is omnipresent in traditional architecture but scarce in Burkina Faso, a country that is mainly savanna with few woods. Despite the importance of earthen walls, building structures tend to rely on forked log columns to support the beams and also build the roof with logs close together, with leaves and bark under the earth of the roof. The trees most commonly used to build beams, joists and ladders are *karité* or shea tree (*Vitellaria paradoxa*), *neré* or African locust bean (*Parkia biglobosa*), African mahogany or

Women collecting firewood for fuel at Baasneere.

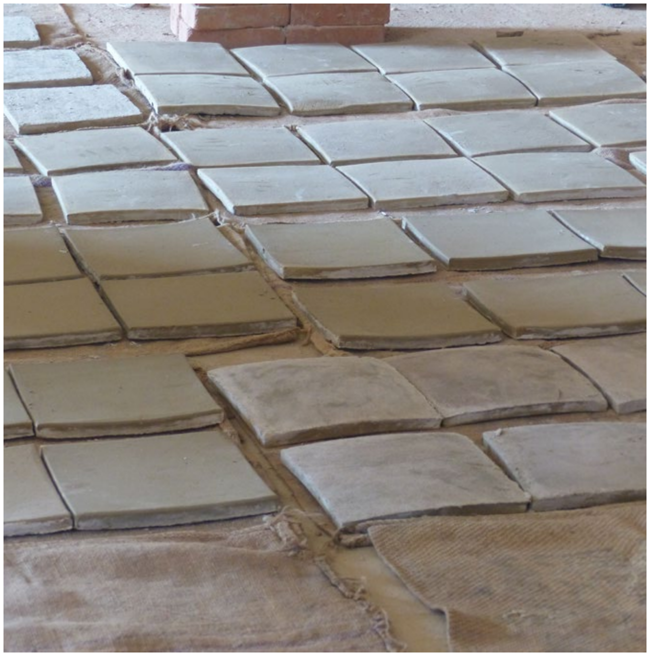
Man transporting firewood in his vehicle near Manega.

dry zone mahogany (*Khaya senegalensis*), neem (*Azadirachta indica*) and others, depending on what is locally available.

These trees are essential to everyday life in Burkina Faso, and not just for building. *Karité* nuts provide the butter frequently used for cooking, which is also used to heal scars. The pulp from the pods and the seeds of *neré* are used as food while the leaves are used for fodder. This tree, which also has antibacterial and healing properties and can be used to treat high blood pressure, has become a medicinal tree par excellence. African mahogany also has medicinal properties and is used as an antipyretic and to heal scars. Parts of the neem tree are edible, and its biological and pharmacological characteristics include antioxidant, antidiabetic and insecticide properties. The branches and trunks of these and many other trees fulfil a basic function: their timber, usually collected by women, is also the main fuel in domestic kitchens and different types of ovens.

Timber is also used for the posts and lintels of sheds, door and window lintels, Y-shaped notched log ladders, pens, and to prop grain stores. The thinner branches are also used to create the conical frameworks for branches on thatched roofs, pens, top of the wall thatching, bird cages, and to guard and protect young trees.

However, the progressive deforestation of the country calls for alternative solutions to the traditional use of timber, including adobe pillars, pilasters, buttresses or widening earthen walls, load-bearing walls or Nubian vaults, as well as other expensive imported solutions with modern materials and techniques ill-adapted to tradition.



Tiles made of clayey mud laid out to be aerated before being put into the ceramic kiln.

Ceramic

Ceramic is found in traditional architecture, not so much in the form of bricks or tiles, which are practically non-existent, but as bottomless pots, which are used as roof skylights to light and ventilate spaces. Although many of these also have their own ceramic cover hoods, sometimes simple pumpkin bowls are used for cover in the event of torrential rain. Ceramic is more commonly found in household items, where the wealth of a home is calculated from the number of ceramic vessels stacked inside it.

Process for the production of ceramic vessels without a potter's lathe.

Sifting the sand for the production of the ceramic tiles in situ at the foot of a building site.

Woman carrying ceramic vessels to sell at the market.

Ceramic vessels used for different purposes.

Current production of precast cement blocks in Banfora.

Others

Inevitably, cement is widely used in contemporary urban architecture, where it is common to find buildings constructed with reinforced concrete pillars and premanufactured blocks. The use of cement, usually between 5% and 10%, is also widespread for manufacturing Compressed Earth Blocks or for producing mortar for masonry constructions, although its rigidity and attraction for salts does not always yield good results. Metal is used in some beams, lattice structures or reinforced concrete frame structures. However, it is most frequently found in the corrugated sheet metal on roofs found scattered throughout the country and in louvered joinery with fixed slats. Aiming for greater durability, watertightness and resistance to damp, other materials used and more recently incorporated are asphalt fabric, bituminous paint and paint mixed with earth, although results are not always as expected. Glazed windows are only found in buildings in cities of a certain size.

Ceramic vessels with Birifor decoration near Navielgane, Bougouriba province

Elderly man and his son explaining the finer details of traditional architecture in Baasneere.

5. Concepts

There are several architectural concepts universally found in traditional architecture throughout Burkina Faso, irrespective of ethnic groups and their specific cultures. These abstract concepts have been grouped as follows: enclosure, receptacle, weaving, shelter, threshold and semi-darkness.

Enclosure

The concept of enclosure permeates most of the architecture and traditional urbanism in Burkina Faso. Enclosure defines the residential space, scattered with individual huts, even progressively dividing off the most private zones. Its outline traces the front porches, winding around the perimeter of the dwellings in search of a rigid inertia for its thin walls. It lays out the folds for the livestock, protecting young growing trees and embracing the space of the improvised shading made of straw mats.

The wall enclosures can be built either shaping earth or overlapping profiled cob courses, perhaps fenced around with sticks for protection from the attack of livestock. The walls can be found in adobe or premanufactured cement blocks, together with low masonry or lateritic ashlar walls, partially perforated woven walls of different types and lattices (increasingly thickly woven to act as windbreaks at face height), and with log and branch palisades. The enclosure can be simply suggested by the shade from a porch or hut. Often the openings of the enclosures are not breaks or mere interruptions in the perimeter, but simply U- or V-shaped partial interruptions which mark out a lower edge that needs to be stepped over.

Shed surrounded by a small log fence.

Improvised yard with a branch palisade.

Circular Birifor yard made up of curved walls of overlapping profiled courses.

Receptacle

The concept of receptacle is widespread throughout the traditional architecture of Burkina, regardless of type of ethnic group and constructive culture. This concept is observed in grain stores or household goods, the large perforated amphorae, pitchers, wide shallow bowls, vessels piled up inside the dwellings, mortars to grind roots or cereals, and in the ceramic or pumpkin soundboxes of the drum and balafon, for example. On a larger scale, the dwelling itself consists of a group of receptacle huts joined by the perimeter enclosure. These huts effectively house the lives of the husbands, different wives and their respective children, the young unmarried relatives or grain reserves, and frequently take on specific characteristic forms depending on each of these functions.

Often, this dwelling perimeter enclosure is built or suggested in the framework of the successive repeated receptacles on different scales. The fenced perimeter of the home includes the outline of the female hut containing the kitchen and its characteristic niches in the form of alcoves or shelves. The bedrooms simply have a bed with a mosquito net on a raised platform while the living quarters include a grain store which in turn is divided into internal vertical or horizontal shelves.

The silos become particularly important in most settlements given their unique separate situation, either within the living quarters or in their immediate surroundings or the settlement. Their unusual conical roof, ultimately dictated by their circular or square geometry, clearly marks them out within the settlement, sometimes joined together in clear groups or rows. The concept of receptacle becomes particularly clear when the conical roofs

Wicker, pumpkin, ceramic and metal vessels in a Bobo kitchen.

When the conical thatched hood is removed, it can be seen that the silos with mats are large containers.

Women grinding grain in mortars made of hollowed wooden trunks.

The traditional drums of Burkina Faso are also another example of the culture of the receptacle.

are removed from the silos to access the interior and take out the cereal. This is also especially clear in cases where the silo takes up a whole room in the dwelling, and is accessed through the mouth in the roof.

Weaving

The concept of weaving is widely found in the architectural culture of Burkina Faso. Mats are often braided, attached and interwoven for very different uses, from the creation of shading to the improvised formation of enclosures, the formation of receptacles for silos or the creation of roofs and conical hoods. This type of weaving is closely linked to solar filters, which are essential for controlling the temperature of the dwelling and its immediate surroundings. Woven mats also generate intermediate spaces, spaces halfway between the outside and the inside, two points which will be examined at a later stage.

In addition to the mats, traditional architecture also commonly makes use of other forms of weaving such as wattle, chicken coops, livestock pens and palisades. This technique is also used for furniture, household goods including cages, baskets, large round baskets, aviaries, wicker armchairs, etc. This skilful interweaving of straw, branches and wicker was closely linked to the production of fishing nets and gear. Above all, weaving was used for cotton and traditional cloth and clothing for the inhabitants of a village, or for the canvas tents of the Tuareg, heavier in winter and more loosely woven in summer. Sometimes you can still see old women using spinning wheels or women using looms throughout the country, although this important

Elderly woman spinning cotton on a spinning wheel.

Two girls with braids, in Bobo Diulasso.

Girl's hairstyle representing the local skill and tradition of working on weaving fibres.

Fabric for sale in the city of Bobo, probably imported.

Double figure of eight yard for hens and chickens in a Gan village.

traditional work has been mainly replaced by imported clothing to the detriment of the country's artisanal tradition and economy. In fact, one of the policies applied by former president Thomas Sankara was the promotion of local fabrics over imported ones, following the example set by Gandhi in India. The aim of this was twofold: to promote identity and to strengthen the economy. Architecture, especially these plant weavings, has been affected by the unexpected appearance of new materials and constructive techniques. However, their high cost, limited availability in rural areas, poor adaptation to the warm climate and the difficulty of adapting the conical shapes of the roofs has saved part of this tradition for the time being.

Shelter

Unlike other colder countries, the notion of shelter in Burkina Faso is especially linked to protection from the sun and, occasionally, the wind and rain. Hence the great importance of sheds, porches, shades, and temporary shelters of branches and trees, which all act as drying racks for the provisional storage of straw, providing heavier shade at the time of year when it is most needed. This need for shelter also explains the importance of the woven straw mats which are still widely used for their versatility and immediate availability, creating or covering breathable enclosures which lower exterior temperature by several degrees.

In Burkina Faso the idea of shelter is also closely linked to the protection of many ethnic groups and subgroups who have traditionally experienced war, raids and attacks from neighbouring tribes. Architecture has responded to

Mushroom-shaped termite nest with a lower section protected from intense rain.

this need by creating closed settlements, accesses to the complex and entrances to the huts which protect residents from potential intruders and enemies. Domestic life mainly takes place in the central courtyards, the flat roofs have skylights to avoid the need for openings to the exterior and the flat roofs become platforms for the defence, surveillance and control of the territory.

Different references to shelter are also clearly seen in the vaults and domes historically found in local culture: the natural caves in the country which provided shelter in turbulent times; the huts with the characteristic dome shape made of plant elements like branches and straw; the

Blacksmiths working metal under the shade of a large tree and several sheds.

improvised vaulted spaces formed by the plant mats which cover the cabins, also enclosed with mats. For centuries, the termites which build their mushroom-shaped nests have demonstrated how umbrella-shaped clay cupolas are also perfectly resistant to rain if properly built and maintained. In fact, the traditional vaults and cupolas of the bread ovens and ceramic kilns, boosted by deforestation and scarcity in timber, have recently increased in scale in order to cover greater spaces in dwellings and public buildings using self-supporting constructive techniques such as Nubian vaults or false vaults.

Threshold

In Burkina Faso, access to buildings, especially dwellings, is generally not direct but rather through a series of filters, often unnoticed by visitors, which provide a gradual transition between the fully public exterior space and the completely private and intimate interior space. In most cases there is not just one threshold, but several successive thresholds. These provide access to the village, entry to the residential enclosure, some subsequent transitions in the form of courtyards, sub-courtyards, steps, platforms, porches and shaded areas, as well as the access threshold, strictly speaking, to each of the individual huts occupied by the husband or his respective wives and children.

Often the design of the only access threshold to the huts incorporates protection mechanisms. These hut thresholds are sometimes so uncomfortably low that outsiders have to crawl into them, in a position which leaves them at a disadvantage. Occasionally these small entrances are accompanied by a lower interior wall which as well as preventing water from entering, further complicates entry into the space for any potential attacker. Equally, the contrast between the blinding light outside and the darkness inside is such that it takes several seconds for eyes to adjust and intruders are once again left defenceless. Strikingly, doors are not part of the mechanism for defending privacy in these huts. In fact, doors have traditionally not been needed as these successive filters provide tacit privacy, while continuously ventilating and illuminating the inside of these huts but, above all, this threshold design provides protection mechanisms.

. Entrance to a Kassena dwelling photographed from inside, with a small entrance and low interior wall with a break which make it necessary to crouch down and mind the step in order to cross the threshold.

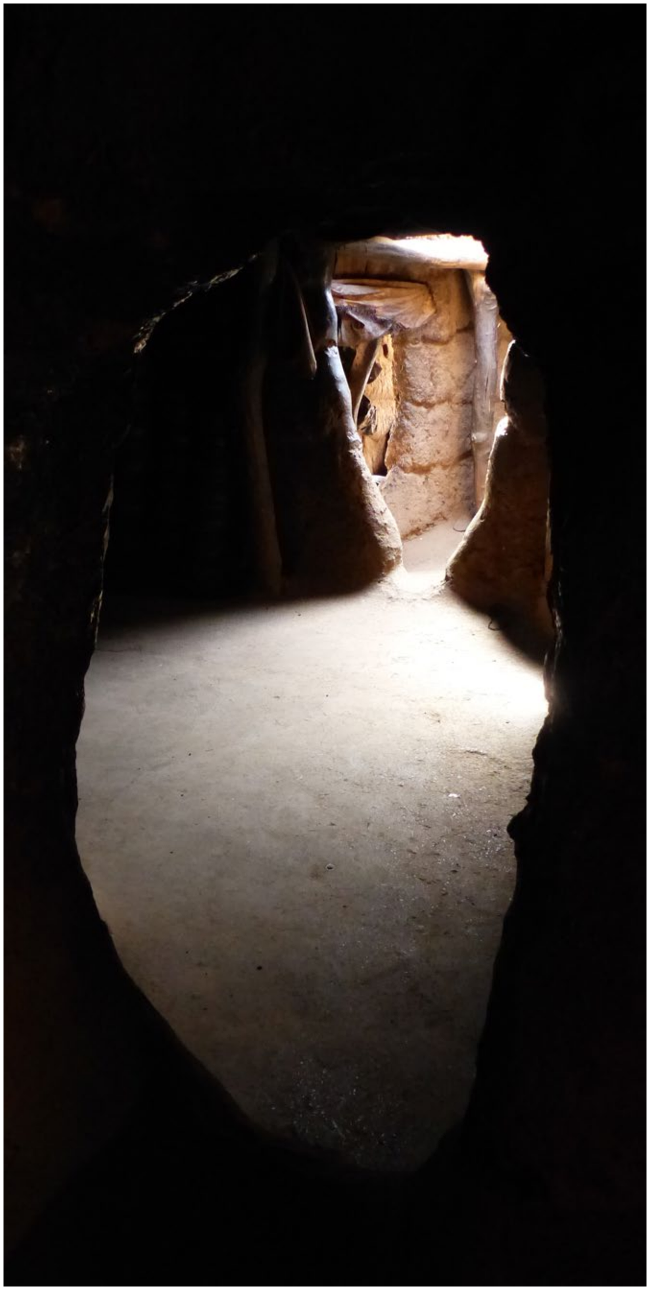
Double threshold of a Bobo dwelling, exterior threshold to the street and interior threshold to the courtyard.

Threshold. Entrance to a Lobi dwelling photographed from inside.

Semi-darkness

It seems odd to highlight the concept of semi-darkness in the traditional architecture of Burkina Faso, a country famous for its blinding sunlight and the diffused light of the dust carried by the wind. However, this concept is especially present inside the dwelling, perhaps in contrast to the dazzling light outside, and it may be subconsciously associated with aggression and lack of protection. This is particularly true in the larger dwellings which from the outside appear as a compact unit. Dark interiors are not only the result of letting little light in but also of frequent dark renderings which absorb the little light entering. These dim interiors are reminiscent of the dark interior of a cave, and this feeling is heightened by the organic and topological space of the architecture. It should be noted that despite the small size of these openings, the interiors are always well-ventilated due to the cross-ventilation from these openings and the shafts or skylights which let hot air out.

This semi-darkness is also perceived in moonlight or even when a single village shares the light of one or very few electric lightbulbs at night. The shapes of the dwellings become dark and compact under the blue light of the moon and the outside of the settlement seems menacing. While semi-darkness reigns inside the dwellings, barely lit by moonlight through openings and skylights, this darkness evokes protection and calm in relation to the exterior, like that of a mother's lap or womb.



Semi-dark interior of a Lobi dwelling, which only lets light in through the doors leading to the shafts and exterior.

Semi-dark interior of a Kassena dwelling, with black rendering, storage for vessels and ceramic vessels dimly lit by a zenithal opening.

Dimly-lit interior in a Kassena dwelling in Tiébélé with kitchenware lit from a skylight.

Donkey seeking shade from the sun between silos in Basnekoudougou, Sanmatenga province.

6. Types of Buildings

The limited number of building types found in the traditional architecture of Burkina Faso can be divided into two major groups: domestic buildings and religious buildings. Among the domestic buildings we mostly find dwellings, sheds and grain stores. The section on housing analyses the dwellings of more than a dozen ethnic groups. The religious building category covers mosques, churches and buildings linked to animist worship. As other types of traditional buildings such as the older schools have now almost all been replaced by buildings with new designs and imported or colonial constructive techniques, these types of buildings have not been included.

Housing

The architectural space of dwellings is shaped by the individual characteristics of the country and takes a specific form in the different cultural enclaves. It can also be argued that, unlike the architectural space which materializes in a specific village and its dwellings, it also fashions behaviour to some extent. The occupant endows these settlements and dwellings with a form which in turn determines the inhabitants. A savanna landscape which is relatively homogeneous throughout the country and shares the same constructive materials (earth, timber and straw) provides an extraordinary range of solutions when these initial conditions are combined with the culture of different ethnic groups or ethnolinguistic subgroups. The landscape component becomes increasingly important in different locations throughout the country with more hilly terrain, exuberant rain and vegetation or thick forests, as is the case throughout the southwest of the country.

The interpretation of space covers all aspects: the territorial aspect linked to landscape; the urban aspect linked to the relationship between the different buildings of a settlement; and the domestic aspect which refers to the inside of a dwelling. The variations can be major, even in a relatively small area within the country, as demonstrated by Jean-Paul Bourdier and Trinh Thi Minh-ha in their famous book.[68] Below are some brief descriptions of the layout of the Birifor, Bobo, Dogon, Gan, Kassena, Ko, Lela, Lobi, Mossi, Nuna, Peul, Puguli, Senufo and Tuareg dwellings.

[68] Bourdier Jean-Paul & Minh-ha, Trinh T. 1985. *African Spaces: Designs for living in Upper Volta*. New York - London: Africana Publishing Company, Holmes & Meier Publishing.

Birifor dwelling built with overlapping courses and cob volumes on the roof.

Interior of a Birifor dwelling with a sort of silo in the shape of a giant amphora.

Birifor woman winnowing grain outside the dwelling.

Birifor dwellings

Birifor dwellings are like fortresses spread out over a rectangular floor plan, with few points of access and ventilation openings in the characteristic walls with overlapping profiled cob courses, which curve slightly every few metres in order to guarantee a solid structure, resulting in extremely appealing and beautiful architecture. The supporting structure of the roof does not rely on these walls, which only need to hold their own weight, but on timber forked logs on which the main beams rest. Lighting generally enters through the openings in the flat roof, accessed through a shaft which is used simultaneously to light and ventilate, to let smoke out from the fire, and to support a Y-shaped notched log ladder providing access to the roof. Unlike other cultures with characteristic winding walls of overlapping courses such as the Lobi, Birifor dwellings usually incorporate a volume of some kind built on the flat roof, with walls occasionally supporting the load of the roof joists. This roof becomes a wide courtyard or additional room outdoors, an extensive platform used for different activities such as drying foodstuff, resting or storage. It was

Reproduction of a Bobo dwelling at Manega Museum.

traditionally used as a watchtower to control any possible enemies lurking nearby. Small thatched hoods that cover the mouths of large carboy-like silos below emerge from this flat roof. The Birifor settlements design large, slightly sloping roofs to allow water to run off. The settlements of the Dagara, Puguli, Dyan and Lobi feature similar types of architecture, albeit with spatial variations indoors from culture to culture.

Bobo dwellings

These constructions with square or rectangular floor plans usually have a ground floor and some sort of volume on the first floor, covered with flat terraces. Thus, these terraces become a useful element which has been perfectly integrated into the house. Access to this earthen roof can be from a Y-shaped notched log ladder leaned on the outside wall, from an interior staircase or occasionally from exterior earthen steps built into the construction. The volumes built on the first floor tend to be closed rooms or simply porches open on one or two sides to provide shade. The water drains from all the terraces through gaps on the edges of the flat roofs, aided occasionally by half-log spouts which drain the water away, preventing it from running down and damaging the walls. The interior is compartmentalized with no corridors, moving from room to room where all the functions of the home are carried out. These dwellings are traditionally built with cob, although in many areas, especially urban ones, they have been built with adobe or even laterite in recent decades. The terraces are built with tamped earth on a layer of leaves and/or bark over a framework of branches, joists and beams supported by forked posts all along the interior perimeter.

Reproduction of the interior of a Bobo dwelling at Manega Museum.

Bobo woman preparing food in the semi-exterior kitchen.

A Bobo woman gathering firewood in front of her house.

A Bobo men sitting at the foot of a house in Sya.

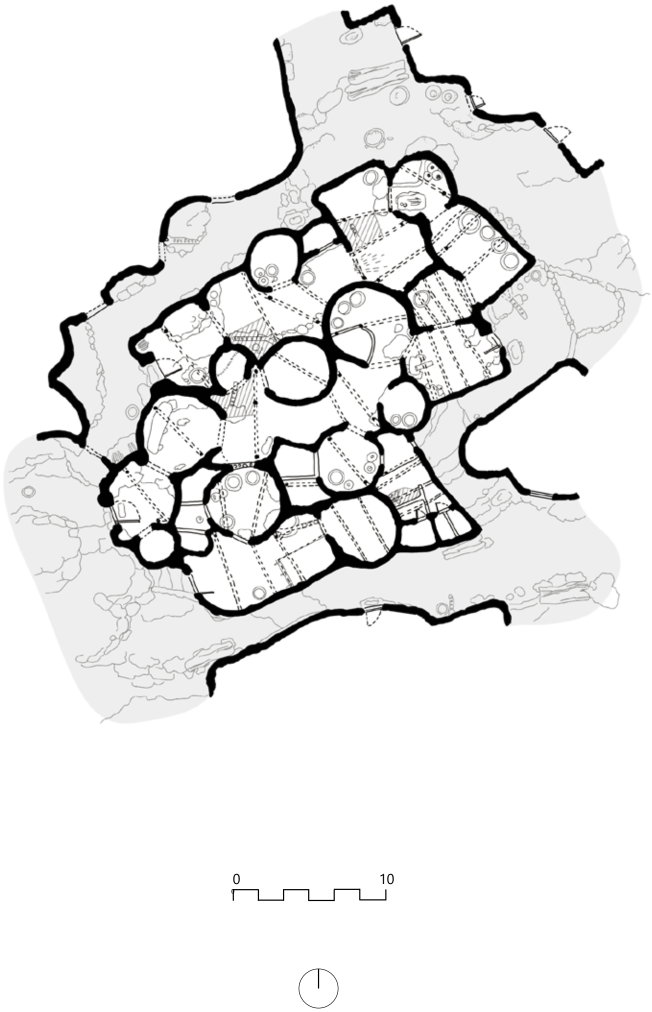
Dogon dwellings

From the outset Dogon dwellings at the heart of Dogon culture adopt multiple forms as they are located in the Cliff of Bandiagara in Mali, and are shaped by their geographical situation on the plateau, nestling at the foot of the cliff or settled in the lower savanna. Dwellings can take the form of shapeless groups of two-storey rooms, clustered with others to form blocks in villages with rocky promontories. These form irregular enclosures which include several huts with specific uses and different surface areas, densities and numbers of floors (one or two) depending on the available space.[69] They may also follow the canonical arrangement described by Marcel Griaule, in the shape of a sitting man, with a courtyard on the top floor in the centre, with the circular kitchen at the head and the rooms at the sides and feet.[70] The position of Dogon dwellings in the thin geographical strip of this ethnic group in Burkina Faso shows the progressive dilution of this culture by other dominant ones and, therefore, of their anthropomorphism within an enclosure built with drystone walls or clay mortared walls, depending on the availability of natural stone near the villages.

[69] Lauber, Wolfgang (ed.). 1998. *L'Architecture Dogón. Constructions en terre au Mali*. Münich/París: Prestel Verlag/Societé Nouvelle Adam Biro; Bourdier, Jean-Paul & Minh-ha, Trinh Thi. 2005. *Habiter un monde. Architecture de l'Afrique de l'Ouest*. Paris: Jean-Paul Bourdier & Éditions Alternatives: 110-117

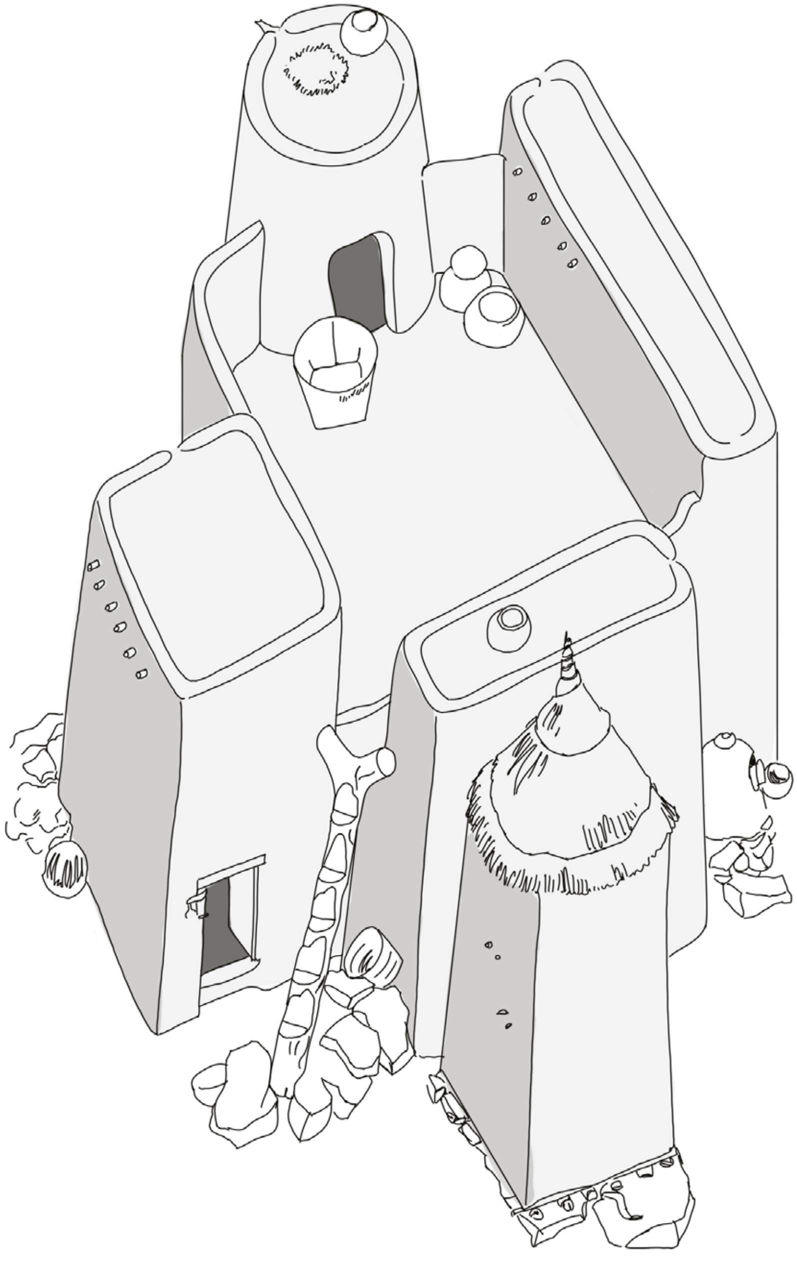
[70] Griaule 1966, op.cit.

Dogon dwelling at the foot of the Cliff of Bandiagara (Mali).



Floor plan of a Dogon dwelling surveyed by Wolfgang Lauber, redrawn by the authors.

Dogon village at the foot of the Cliff of Bandiagara (Mali).



Axonometry of the Dogon dwelling according to the survey by Bourdier and Minh-ha, redrawn by the authors.

Gan dwelling with an entrance porch.

Gan dwellings

The Gan are a small ethnic group with 14,000 members, originally from Ghana. Their language, Kaansa, is part of the family of Nigero-Congolese languages within the Gur group of languages or Voltaic languages (therefore related to Mooré, Gourmantché, Gurunsi, etc.). They are unusual in having a monarchic system of government with their own king. The complex of the dwelling is made up of circular huts with conical thatched roofs. Although these are generally built in adobe, less frequently they can be found built in laterite, occasionally rendered with lumps of mud. Some huts have an entrance porch which is covered by the extension of the conical roof, resting on three or more wooden posts. The porch also has a low wall at the end which supports the uprights and is simultaneously used as a bench to sit on. It may be closed off by a wall at the side or include an arch from its perimeter to the thatched roof, depending on orientation and the

Group of women and children around the Gan hut-dwellings.

Gan woman grinding tiger nuts at the foot of her hut.

Children running in a Gan village made up of hut-dwellings.

Chicken coop and yard of a Gan dwelling.

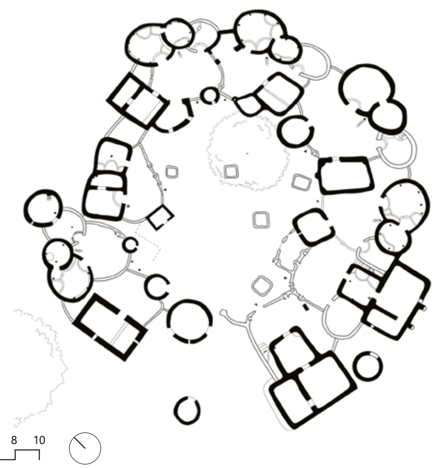
need for climate control. Recently rectangular huts with corrugated metal roofs have sprung up, eliminating the need for a thatched roof and lightening the load on the walls given that the sheet metal is lighter. However, this not only entails the loss of tradition but also of the bioclimatic advantages provided by thicker walls and thatched roofs, leading to warmer and more insalubrious conditions indoors. The sanctuaries of the fetishes, which include huts "inhabited" by each of the ancestors, have recently been reworked as rectangular huts in laterite masonry with rounded corners and thick reinforced concrete slabs.

Kassena dwellings

The *sonron* or complex of the Kassena dwelling groups together different homes, whose main entrance always faces west. A complex can house between 15 and 40 inhabitants from a single extended family, and is made up of a circle of huts clustered around a *naba* or shared central courtyard. The family chief or founder creates an initial enclosure which grows progressively, either horizontally or slightly staggered, depending on the surrounding terrain. Each of the women has her own hut with a living room and bedroom, where she lives with her daughters until they get married, while her sons live there until they are 20 years old. Once they reach this age, the sons leave home to build their own huts at the back of the family enclosure.

The rooms can be polygonal, with small windows for lighting and accessible tamped earth terraces, or circular, with zenithal skylights and similar terraces. The space for the father of the family or *manguelo* is rectangular and generally points to the east, which is the symbol of man. The space reserved for women and usually pointing to the West, symbolizing women and the moon in association with their menstrual cycle, is a more or less circular courtyard surrounded by the *diniya-didiyou* or huts in the shape of an eight or of intersecting circles in which we find the living room, kitchen (*koura*) and household goods. The skylights tend to be above the kitchen in order to let smoke out or in the area where grain is milled. There are also circular huts with conical thatched hoods. These may be grain stores (*toule*) if they are narrow or be used as temporary accommodation for single men (*droa*).

Complex of the Kassena dwelling of the Alampoa family in the village of Langouérou, according to the survey by H. Kobayashi & S. Barthoux, redrawn by the authors.



Complex of the Tanga Kassena dwellings in the village of Tangasoko, according to the survey by Bourdier & Minh-ha, redrawn by the authors.

Kassena royal court of Tiébélé, according to the survey by DPC-CRAterre, redrawn by the authors.

Kassena dwelling photographed from the courtyard, with its characteristic polychrome decoration.

Kassena dwelling with a figure of eight floor plan, assigned specifically to women.

A Kassena man taking a nap under a large tree.

Interior of a Kassena dwelling with a low wall outside the low entrance door, hindering access to the interior.

Other elements in the dwelling enclosure are the *naboo* or courtyard for animals or the *tugu* or shed for animals.[71]

The transformation process for this type of traditional settlement has been studied in detail given the extraordinary nature of these colourful settlements.[72] In the 1970s a new type of rectangular hut –*tol-dige*– covered with

[71] Niggli, Urs & Niggli, Idda. 2014. *Traditional objects and modern objects. Glosario Kassem-English*. Ouagadougou: Summer Institute of Linguistics (SIL)

[72] Kobayashi, H.; Shimizu, T.; Ito, M.; Nakao, S. 2018. "Transforming Kasena houses and indigenous building technology in Burkina Faso", in Mileto, C.; Vegas López-Manzanares, F.; García-Soriano, L.; Cristini, V. 2018. *Vernacular and Earthen Architecture.* London: CRC Press, p. 147-152; Shimizu, T.; Nakao, S.; Kobayashi, H.; Ito, M. 2018. "Transformation in the Kasena's large earthen compound houses in Burkina Faso", in Mileto, C.; Vegas López-Manzanares, F.; García-Soriano, L.; Cristini, V. 2018. *Vernacular and Earthen Architecture*. London: CRC Press, p. 343-348.

Woman riding her bicycle at Pô.

Kassena women transporting mud to carry out tasks for the maintenance, rendering and polychrome painting of the walls.

corrugated iron became popular given the ease of construction. The metal provides immediate roofing and as it is lighter, walls can be thinner. However, the huts are no longer cooled by the thick walls and roof and become veritable ovens in the blazing sun. For this and other reasons there are currently also huts for women which are simply square or circular.

The inside of all these huts houses sinuous shapes, benches, storage for vessels, a hearth with two fixed feet and a moveable one to adapt to the different sizes of pans, workbenches and platforms to sleep or sit on (*gauro*). Their characteristic internal darkness is accentuated by the dark colours of the rendering. Since the introduction of the *tol-dige*, the use of corrugated sheet metal has made the inside of the huts so hot that the *gauro* or platforms for sitting or lying down at night are now becoming more abundant.

Kassena women decorating dwellings in the typical polychrome style.

The multifunctional terrace is accessed either from a Y-shaped notched log ladder (*natan*), or from earthen steps built into the construction, and is used to store belongings, dry the grain and condiments, and rest or sleep

Opposite the enclosure of the dwelling there is usually a large tree providing shade, generally ceibas (*Ceiba pentandra*), African mahogany (*Khaya senegalensis*) or baobab trees (*Adansonia digitata*), at the foot of which logs are laid out for sitting, gathering or simply taking naps. Access to the enclosure joins the exterior courtyard – *mantiongo* – and the interior courtyard of the dwelling. A *pwuga* or pergola can occasionally be found outside the dwelling enclosure, providing shade.

Kassena villages usually have families of master builders who supervise the building operations, with labour provided by the interested party and the help of neighbours and

Floor plan of a Ko dwelling according to the survey by Bourdier and Minh-ha, redrawn by the authors.

other villagers. The construction ritual begins by asking for the permission of the goddess of earth to occupy a plot. Once this is approved the occupant begins the process of cleansing and purification. Subsequently the east-west axis is redrawn and the huts are built. Finally, the women work on the fixed furniture indoors, renderings and decoration.[73]

Ko dwellings

The Ko create another type of domestic setting, as seen in the Okano settlement of the village of Ko, where domestic spaces – mostly long and rectangular – are joined perpendicularly to the *djau* or communal courtyard.[74] The *tànpal* or space for women, the *djanara* or space for storage, the *djanibiè* or space of the married man, and the *badien* or space of the single man are all rectangular, adapting the ratio so that the long side is up to four times as long as the shorter side. The *viè* or freestanding silos are usually found at the entrance to the *djau* or courtyard of the enclosure. In other Ko settlements these rectangular rooms are not necessarily laid out perpendicular to the courtyard, but can also be built in parallel depending on the situation. However, the walls will probably be thicker to

[73] CRAterre-ENSAG 2014, op.cit.

[74] Bourdier & Minh-ha 1985, op.cit.

Floor plan of an inhabited Lela complex according to the survey by Bourdier and Minh-ha, redrawn by the authors.

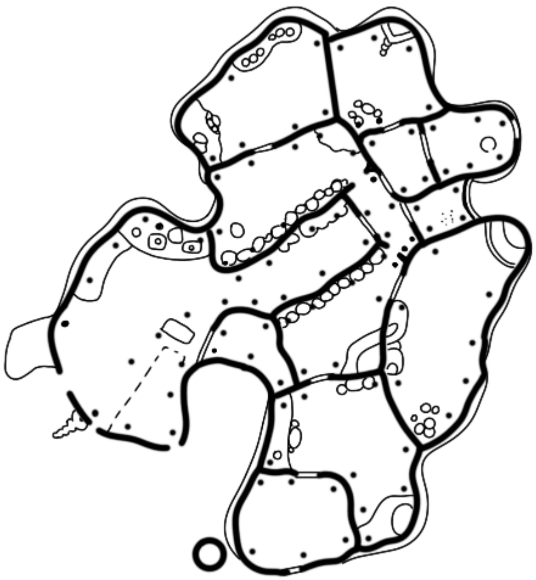
support the ceiling structure and the weight of the roof. The structure rests on timber pillars placed next to the walls but separated from them. Given that these inner spaces are so cramped, they are ventilated with small outside windows or sometimes through skylights made of ceramic pots set into the flat roof.

Lela dwellings

In Lela settlements like Ziuma in the village of Poa,[75] the large enclosure is fenced in by the dwellings themselves, which form a perimeter of clustered bubbles with few points of access to the interior. This creates the *kéleu* or large internal esplanade which mostly houses the grain stores and farm animals running around, harking back to a protection which was necessary long ago and an inward-looking distrust of the surroundings.[76] The complex is reminiscent of the closed circular formations of bison protecting their young when they sense the attack of a predator. The

[75] Ibidem

[76] Bourdier, Jean-Paul & Minh-ha, Trinh Thi. 1982. "The Architecture of a Lela Coumpound", *African Arts* Vol. 16 n° 1: 68-96; Bourdier & Minh-ha 2005, op.cit.: 102-109; Pecquet. Luc. 1994. "Approche ethnoarchéologique de l'habitat lyela (Burkina Faso)», *in* Alexis B. A. Adande, Aziz Ballouche, Obaré B. Bagodo (textes réunis par). 1994. *Dix ans de recherches archéologiques en Afrique de l'Ouest: perspectives de coopération régionale* (Actes du Ve colloque de l'Association Ouest Africaine d'Archéologie [Ouagadougot 1992], West African Archaelogical Association, Porto-Novo: A.O.A.A./ W.A.A.A.: 39-76.



Floor plan of an inhabited Lela complex according to the survey by Giovanna Antongini and Tito Spini, redrawn by María Lidón.

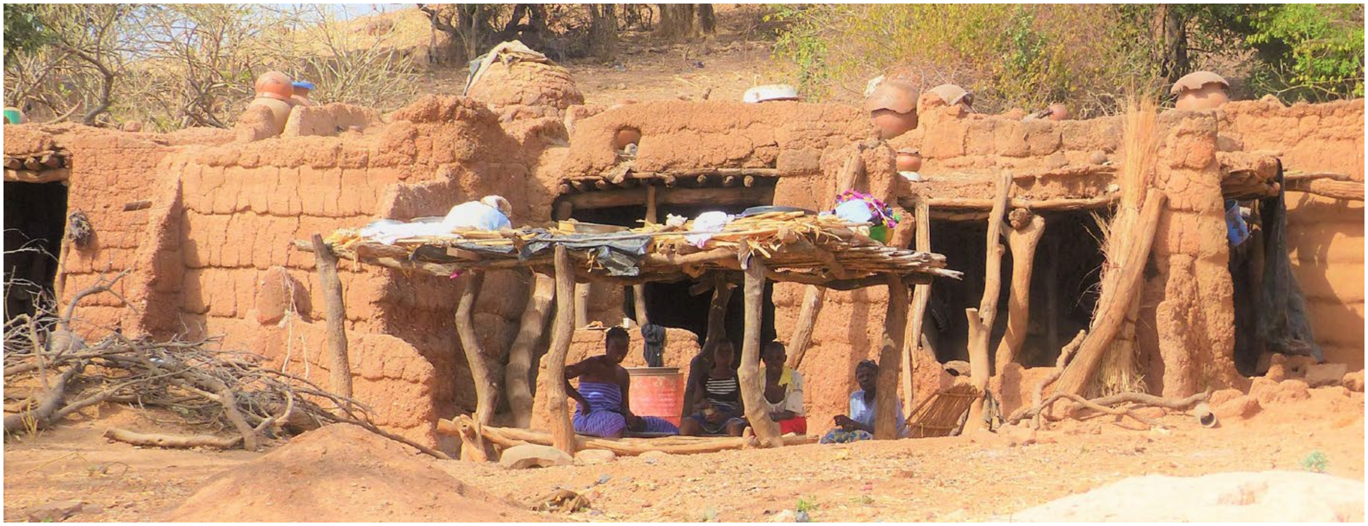
dwellings themselves, made up of four, five or six of these huts with an oblong floor plan and thin interconnected walls, generate interiors which tend to be concave and quiet, compared with the downward tapered convex forms seen from outside. This type of clustered building needs to resort to the flat compacted earth roof, as it would be impossible to cover them with a straw roof. As the thin curved walls are not strong enough to withstand the weight of the roof, the structure rests on timber pillars or strong wall buttresses. The architectural and constructive solutions of this people are therefore governed by their concept of cultural space.

Lobi dwellings

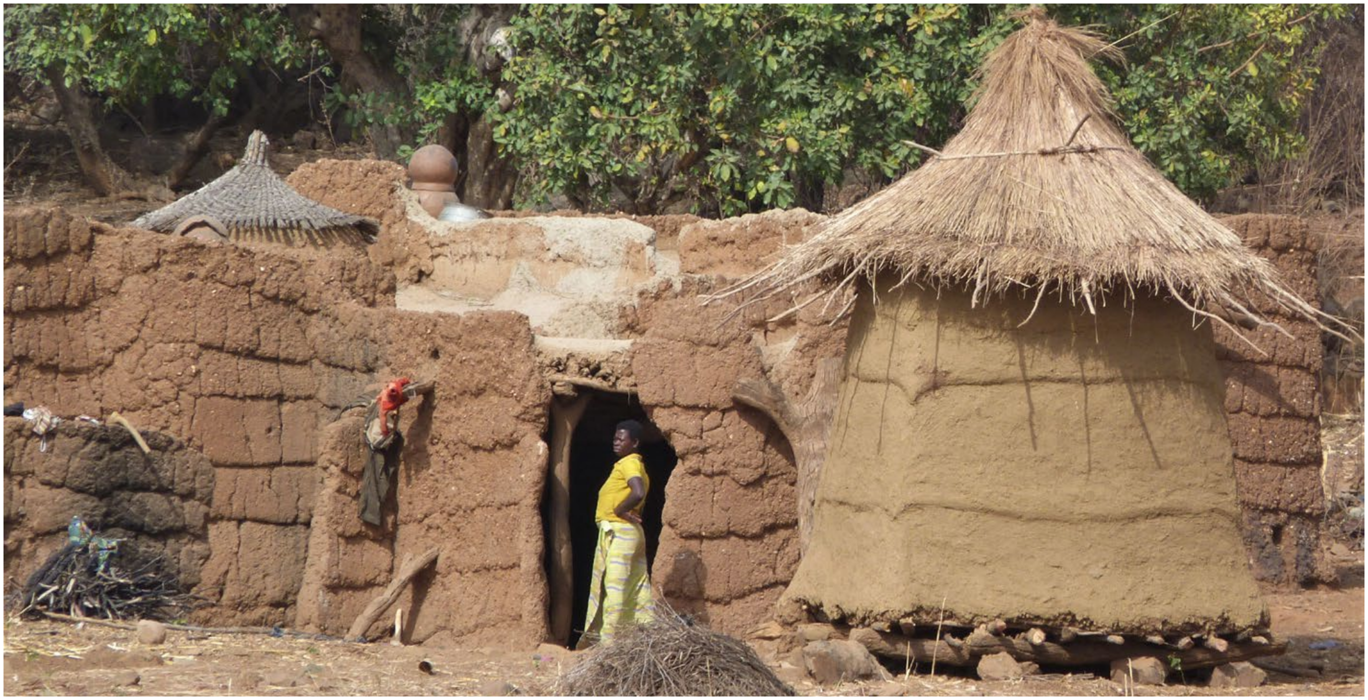
Unique in Burkina Faso, the Lobi dwelling or *sukala* stretches out and is only one storey high. The upper terraces become improvised watchtowers to warn of enemies lying in wait, to collect the grain from the silos through the openings on the roof, or to sleep in the open at the hottest time of the year. Its perimeter is made up of walls of overlapping courses winding to increase rigidity and resistance, creating uniquely beautiful curved walls with strips. This continuity is broken at times, when walls of overlapping courses perpendicular to the perimeter are also built as buttresses. However, the resistant structure of the dwelling does not rest on these walls but on forked timber posts beside the wall around the perimeter. There are one or several accesses to the interior of the dwelling, which provide light and ventilation as there are no windows of any sort. Occasionally some courtyards or ventilation shafts are opened up in this mass of buildings. The interior of the dwelling is therefore quite dark or at least mainly in semi-darkness.

It should be added that *sukalas* also satisfy defensive and religious needs. The defensive function can be seen at the entrance door, which is V-shaped to force possible enemies to slow down, in the generous internal surface where there is enough space for livestock, grain stores and a water deposit; and in the many hidden bends which hinder the movement of potential intruders. The religious space includes a room inside for family fetishes, with an opening communicating with the main fetish and in turn with the fetish of the terrace, acting as a sort of communication scale of domestic fetishes leading up to the supreme god.

Courtyard of a Lobi dwelling with a woman preparing food. To the right of the woman a silo can be seen on the corner, slightly elevated in relation to the walls. There is another silo, in the form of a large mud carboy whose mouth projects from the roof, half-covered by tires.



Lobi dwelling with characteristic walls with overlapping courses and an entrance porch offering protection from the sun.



Lobi woman at the entrance to her home, beside a freestanding silo.

Elderly Lobi woman following the ancient tradition of encrusting stones above and below her lips.

Stews cooking opposite several Lobi silos.

Lobi children crouching behind the enclosure wall of the courtyard of a dwelling.

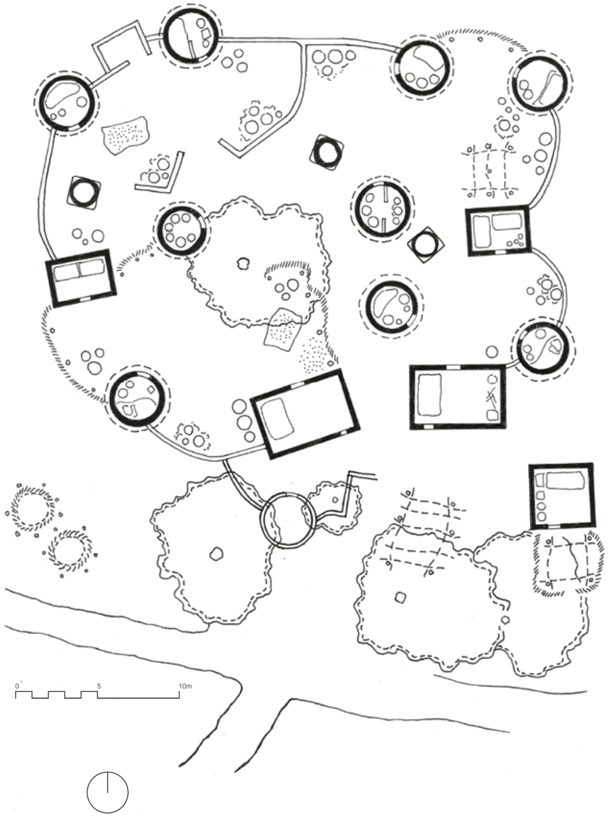
Mossi dwelling with a shelter, low walls, rectangular huts, spaces improvised with mats, and circular huts.

Mossi dwelling

This dwelling is made up of a series of circular huts or square constructions which are independent but close together. The enclosure provides cohesion by embracing these to form the communal courtyard, the communal space of the dwelling in the open air.[77] These constructions, similar to the rooms in Western homes, are generally occupied by a single person with small children. Each may have a secondary private courtyard or a space filtering the access to their immediate surroundings. The evolution of the dwelling and its enclosure is a response to the growth of individual families.[78] The enclosure can

[77] Domian, Sergio. 1989. *Architecture Soudanaise. Vitalité d'une tradition urbaine et monumentale: Mali, Côte-d'Ivoire, Burkina Faso, Ghana*. Paris: L'Harmattan: 24.

[78] Lidón de Miguel, María. 2019. *Baasneere (Burkina Faso). Estudio*



Complex of Mossi dwellings in Baasneere, surveyed by María Lidón.

grow from its original nucleus as children are born and leave home, either adding to or articulating new interlinked courtyards or generating new enclosures nearby. Dwellings, which always look inwards to the enclosure, appear from the outside to be closed and detached.

urbano, tipológico y constructivo. Unpublished Master's Thesis. Valencia: Universitat Politècnica de València.

In the Mooré language these dwellings outlined with enclosures or family residential units are known as *zaka*. The huts with a circular floor plan are called *roguilga* and the rectangular ones are *rogo*. The oldest photographs we have of Mossi dwellings suggest that the traditional huts were mostly *roguilga* with a circular floor plan with a conical roof structure and thatched hood and that those of the rectangular floor plan or *rogo*, covered with a tamped earth roof, were then the exception which proved the rule. Currently both

Women carrying firewood on their bicycles on the vicinity of Ouagadougou.

Mossi women extracting water from the well.

Woman showing the domestic process of grinding grain in Kaya.

Two silos with a pointed bulbous thatched hood, along with a shelter equipped with a thick layer of straw.

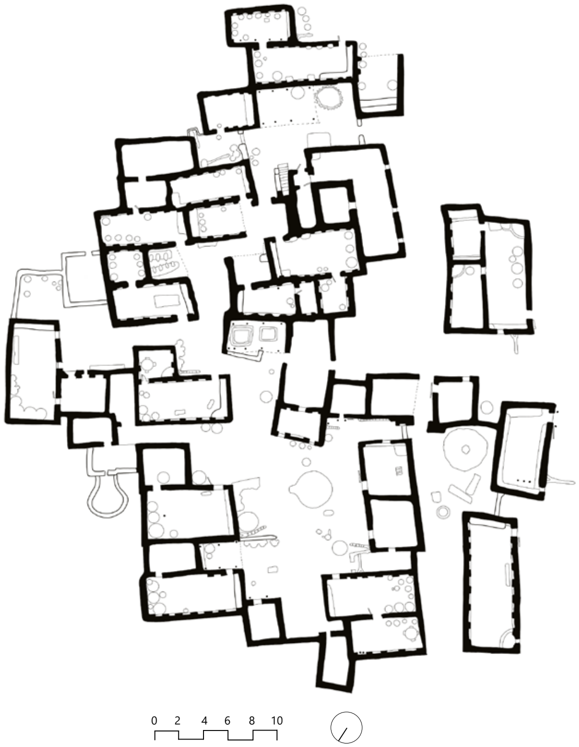
types of hut coexist but it could be held that rectangular *rogo* are more common due to the greater ease of attaching them, choosing adobe as constructive material, building the structure of the roof and waterproofing it with corrugated sheet metal.

Individuals are so identified with their own hut that upon their death, the door and window can be bricked up. The date of death is written on the wall and the construction is left as a reminder of the deceased. In extreme cases, death can lead to the abandonment of the entire concession of the dwelling to build a new one.

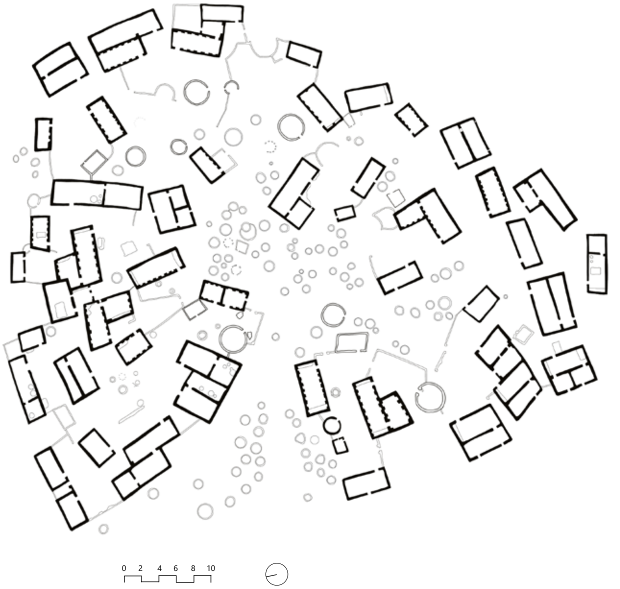
Nuna dwellings

According to Bourdier and Minh-ha[79] there are compact Nuna settlements like the Badu settlement in the village of Pouni, or scattered Nuna settlements, like Buma in the village of Valiou. In the compact Nuna settlements, the floor plans of these buildings are rectangular or square and they are articulated and attached to each other roughly following Cartesian axes. In this case, the settlement is made up of the *diè* or rectangular huts of the wives, adjoining their

[79] Bourdier & Minh-ha 1985, op.cit.



Badu complex of Nuna dwellings, built in 1939 according to the survey by Bourdier and Minh-ha, redrawn by the authors.



Buma complex of Nuna dwellings in Valiou according to the survey by Bourdier and Minh-ha, redrawn by the authors.

bobuin or square annexes for storage or kitchens. Together with the *dibi* or rectangular men's huts they form L-shapes. The routes between the huts are irregular, opening and closing, creating frequent bends, sometimes expanding to generate *nuwos* or courtyards and closing perspectives, probably originally for defensive reasons. However, the seemingly chaotic layout answers to internal grouping laws.[80] As with the Lela settlement described, this inward-looking settlement seems to ignore the exterior and is protected by its hermetic perimeter, which tends to be compact, and where even the grain stores in the form of large earthenware jars are integrated into the construction. In fact, this arrangement reflects historic aggression from their Mossi neighbours. Only flat terraced roofs can be built on these parallelepiped huts as they are grouped so closely together. In this case, however, the walls are thick enough to be load-bearing without the help of buttresses or timber structural pillars.

As in the previous case, the dispersed Nuna settlements, the *diè* of the women, the *dibi* of the men and the *bobuin* for storage are rectangular

[80] Bourdier & Minh-ha 1985, op.cit.

and square, seemingly arranged at random and loosely arranged around the silos, which are freestanding and also scattered around the natural entrance to the settlement. While the men's *dibi* have bare walls, the women's *diè* are often decorated. Most of the time, the *nuwos* or courtyards have no physical border delimiting them but rather are open shapeless forms opposite the entrances to the women's *diè*. The tamped earth roofs are also flat. The walls are also thick or have internal buttresses so that the ceiling and roof structure do not need to rest on timber pillars. Bourdier and Trinh-ha[81] have poetically described Nuna dwellings as a ceramic object of light and shade, where light should be understood as the life of the space and the darkness as its soul.[82]

Peul dwelling

These dwellings are extremely simple: round huts with aerodynamic shapes built with straw or woven mats spread out over a lightweight radial structure of branches bound with rings in the same material. In huts with large diameters thicker branches can be used as central support, sometimes multi-branched at the top, securing the central hoop on which the radial branches rest. The Peul nomadic camps are built on the outskirts of the cities in groups of at least a dozen huts.[83] Often, however, especially in the case of semi-nomadic families already linked to a village, they may be individual and actually stand alone rather than in groups. Sometimes when the Peul

Peul dwelling on display at Manega Museum.

Interior of Peul dwelling on display at Manega Museum, with the stacked vessels from its household goods.

[81] Bourdier & Mihn-ha 2005, op.cit.: 42-45.
[82] Bourdier & Minh-ha 2005, op.cit.: 42-45.
[83] Vidal, Miquel. 2009. *El País Dogón. Breu quadern de notes i emocions*. Barcelona: ETSAB: 104.

Interior of Peul dwelling on display at Manega Museum, with the central forked log supporting the roof and the bed platform.

have become semi-sedentary, sheds are found alongside the dwellings to store fodder and provide shade for livestock. The pens are built with branches or thorny plants.

The interior is a single circular space, lit through the walls of mats woven in herringbone and loosely woven to let air through, generating a much cooler space than one might expect. In contrast, the thatched roof is tightly woven to prevent water from getting in, but lets steam through perfectly, contributing to the interior microclimate of the dwelling. There is a single entrance with jambs knotted from the concentric mat and a lintel at the level of the edge of the thatched hood on the roof.

The large huts can house *lèeso* or sleeping platforms made up of four posts, lintels and branches under straw mats, which make it possible to sleep without touching the ground. These platforms can even be double, like bunk beds. They are easily assembled and dismantled by putting together or setting the lintels in the notches of the uprights. They also usually incorporate a *kaggu* or shelf to hold objects used for milk, a *kaggu caggalèèso* or shelf at the head of the bed, a *penngal* or shelf for storing grain and the men's tools, and a *miidu* or branch platform used as a seat for visitors.[84] In addition to other belongings, clothes and household goods, various *loonde* or water pitchers and many ceramic cooking dishes are stored inside, with several hanging pumpkins for storing food supplies out of the reach of animals.[85]

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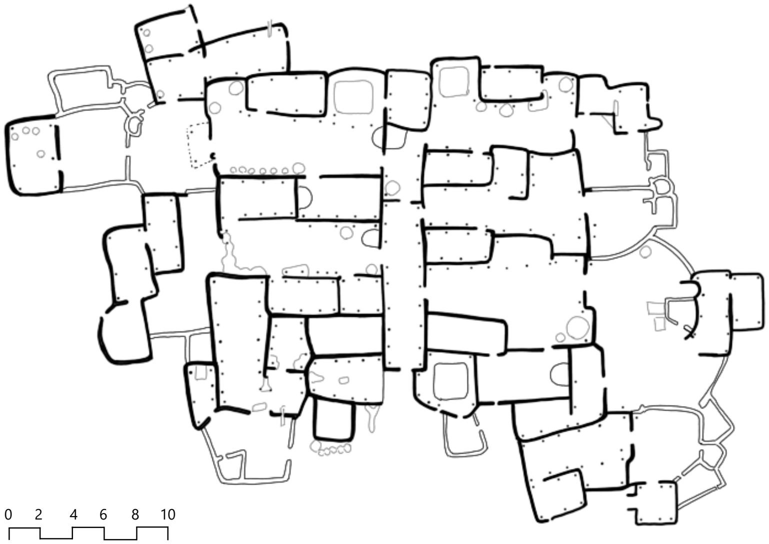
[84] Bourdier & Minh-ha 2005, op.cit.: 172-183.
[85] Beaudoin 1998, op.cit.: 20.



Complex of Puguli dwellings according to the survey by Bourdier and Minh-ha, redrawn by the authors.

Puguli dwellings

The Puguli or Pwa have a different type of settlement, as can be seen in the Zingè family complex in the village of Nyiémé, a hermetic domestic complex which could almost be described as fortified, prepared for defence from the exterior. Built with walls of overlapping courses, sinuous forms and rounded curves, with barely any windows open to the exterior, the architecture is highly dynamic. Thus, the communal dwelling becomes a stimulating source of artistic creation.[86] The dwelling traditionally incorporates a single entrance leading onto a *zapo* or entrance corridor, which gives access to the different areas of the house. The *dantiaga* or interior kitchen, the *zupuè* or men's space, the *zarè* or main space for domestic chores and rest, and the *dawolo* or small private courtyard are oblong cells grouped together or almost touching, with large interstitial spaces, usually occupied by the *zarè* or main living quarters. The *dawolo* leads to the roof with a Y-shaped notched log ladder.[87] The *viubéla* or silos, built shaping earth by hand, are formed with enormous carboys or broad-based bottles with small mouths which protrude from the roof and are protected with a thatched hood. Occasionally there may be a *viu* or exterior silo beside the access.

[86] Bourdier & Minh-ha 2005, op.cit.: 52-59.

[87] Bourdier & Minh-ha 1985, op.cit.

Senufo dwelling built sheltered by a large tree.

Senufo dwellings

The houses are traditionally circular huts with thatched roofs, used as either daytime rooms or bedrooms. The lodgings of the head of the family may be rectangular with a flat roof on which spices are laid out to dry. Each wife in this polygamous society has her own sleeping hut and her own kitchen. In fact, having a kitchen of one's own is a sign that the wife has been completely accepted into the family. The circular kitchen huts hold utensils, pots, bowls, baskets, food, a stone mill and stools for close family members and visitors. Food is prepared inside these kitchens, although in special cases for large groups, all the women of the complex-dwelling collaborate, using larger utensils to prepare the food outside. The grain stores, built on large stones and a timber base, are cylindrical with a conical thatched hood. The interior is usually accessed through an opening at the top and occasionally accessed through steps at the side. All the family members and neighbours are involved in the construction of a hut of any of these types, helping to make the

Senufo dwelling with a pile of dry corn leaves used as kindling.

adobe and build with it. These huts of the Senufo dwellings display a scattered open layout and are not grouped together in a physical enclosure.

Tuareg dwellings

These tents, which are the homes of married couples, are built by women using animal skins, fabric or basketwork. Two openings, front and back, generate air currents helping to cool the inside. In all cases, the hot air inside the tent rises so that temperatures are lower at ground level where the inhabitants sit. The summer tent is sometimes made of braided mats spread out between the posts, tied with leather strips and occasionally tightened with ropes. They are completely open on all sides, providing shade as well as continuous breathability. Everyday life is organized under this awning, with all the necessary elements of household goods, kitchen utensils, fabrics, clothing, etc.

Shed with straw stored in intercrossed layers on the roof and used simultaneously as a goat pen.

Sheds

The shed is a constructive typology frequently used in Burkina Faso. It shades from the sun and is generally open on all four sides to let the breeze circulate in all directions. Its traditional thatched roof allows breathability and helps cooling, although recently this has occasionally been replaced by corrugated sheet metal. The most common examples are domestic sheds and markets.

Domestic sheds are generally square or rectangular, consisting of a set of pillars of forked trunks which support an upper layer of branches, on which straw is usually placed in intercrossed strata, helping to increase the

Sheds are a fixture in the landscape of Burkina Faso.

Shed with straw on thick forked posts providing shade and shelter to the livestock.

Trees used as hayricks taking advantage of the strong branches for storage.

Rare shed on adobe pillars with a gable roof near Koudougou.

shade provided by the shed and provide food for the livestock throughout the entire year until the following season. Sheds usually have three pillars per side, that is, a total of nine wooden posts, but there are examples of 4, 5 and up to 7 pillars per side, forming sheds of 16, 25 and up to 49 wooden posts. In general they are high enough to allow a person in without needing to crouch, but are barely two metres high. They are widely found throughout the country and have different names depending on the local language: *apatam* in local French, from the Ewé language, perhaps originally from the Portuguese *patamar* (level); *zandé* or *zanpabré*, if the shed is very large, in Mooré; *waa* in Lobi; *chiot* in Dagara; *gbata* in Yulá; *sëé* in Birifor; etc. These sheds, like strange haystacks on uprights, are vitally important to the life of the

Dogon toguna or shed providing shelter to the meeting place for the elders. It is made up of a set of very low uprights supporting a temporary branch shelter which is often thicker than the narrow space it covers.

Shed improvised with mats on posts for a Mossi wedding banquet.

community: they shelter animals and men from the sun and let in breezes on all sides. They are used as gathering or work places or simply as somewhere to sit in the shade. Often, the welcomes of the *naaba* or village chiefs take place under a shed, transformed or used for dialogue. Equally, they are combined with a light palisade, a low adobe wall, or at worst, plastic sheeting, to pen, protect and shade zebus or goats.

It is also very common to use the tops of deciduous trees as haystacks to store straw or hay, thus creating what could be defined as a *patam* on a strong single post: a live tree trunk. In these cases the branches even help to raise and hold down straw on windy days. Occasionally these trees are used as a reserve to store the straw which does not fit into the *patam* below. In other cases, these trees are used to store the straw of cultivated fields are far from the village.

It is worth noting the very similar structures in the nearby Dogon Country in Mali, which are almost certainly connected. These are the *toguna* or sheds found in each village as a place for meeting and decision-making for the ruling elders. The *toguna* are also made up of a set of uprights which hold up branches. However, this is where the likeness ends, as the low uprights, about a metre high or just over, force those inside to either sit or recline. According to the Dogons it is impossible to get angry in this position, as you need to be standing to get furious, so that in this case it could be held that the architecture helps keep the calm needed for these meetings


Women selling vegetables on the outskirts of Kaya.

Transporting goods and chickens to the market near Pô.

Structure for a Birifor market made up of a large group of shelters.

of the council of elders. In addition, the layers or interwoven branches intercross until they are about two metres high so that the thick shed roof is higher than the space below. In some parts of Burkina Faso closest to Mali, such as the villages of Koro and Bobo-Dioulasso, there are structures similar to the Dogon *toguna*. They are known as houses of the word and have very low ceilings. As with the Dogons, women are forbidden from entering.

However, markets are much larger and widespread structures made up of wooden logs set in the ground with beams stretching over the end of the forked logs or simply tied. Sometimes a layer of straw and reeds, or occasionally a braided mat or canvas, is spread over them. The standing height is barely two metres. These structures, which can be up to 1000 m^2, can form streets that open up between the roofs, partition walls, rocks used as counters, improvised stone seats, etc. These structures form an enclave at the crossroads or on the outskirts of villages where local inhabitants are gathered on specific days and times depending on local needs and activity. Continuous maintenance is required, particularly for the straw roof.

Woman transporting carrots for sale near Laongo.

Two Mossi silos, one covered with a plant hood and another exposed while the straw is replaced on the conical structure with branches.

Silo

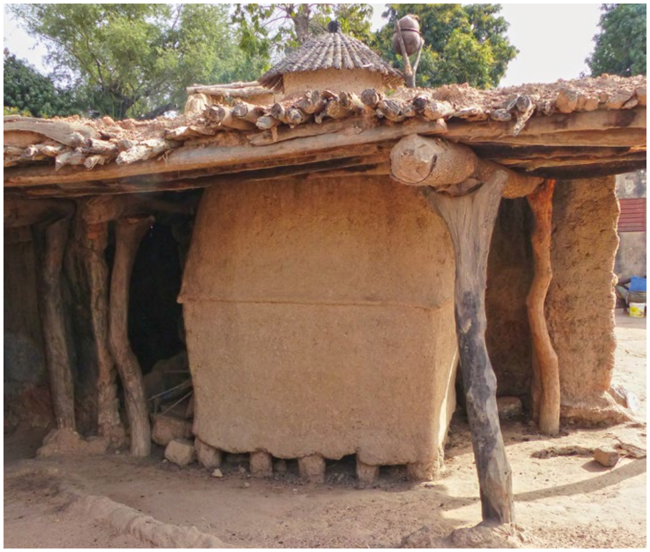
A fundamental element of daily and domestic life for the inhabitants of Burkina Faso are the grain stores or silos used mostly to store millet, sorghum, corn and peanuts and sometimes also spices, household goods or other objects. These are all containers raised from the ground to avoid damp and water runoff in the rainy season. There are two major types of deposits: the Mossi grain stores built in the shape of two large baskets of interwoven mats resting on timber struts and covered with thatched hoods, commonly found in most of the country, and the silos built with mud walls slightly raised on a base of stone or laterite masonry, covered with either a vault or dome, a thatched roof, or both.

Mossi silo without a drum base, cinched with cord, in the shape of an inverted conical pannier resting on the ground and a perimeter of forked branches.

Cylindrical Mossi silo with a drum base and interwoven straw walls reinforced with vertical rods tied with bands of branches.

Plant grain stores are built on a framework of branches on stone masonry or laterite. They are very similar to Galician *cabaceiros* in Spain, but are larger, up to 1.5 - 2 m in diameter, and with a thick and tightly woven layer of branches rather than the intercrossed wattles of their Galician equivalents. There are two major variants. They are often large baskets with a base shaped like an open bowl, contained and propped up at the perimeter by forked branches set in the ground. These are tied at the top with a plant strip to prevent the bowl from opening. If the selected branches have very low forks, the framework at the base can rest directly on them, eliminating the need for elevated masonry bases. Within this group suspended on forked branches there are grain stores without a base but tied together with cord at the bottom to form an inverted conical pannier resting on the ground.

There are also cylinders with a drum base and woven straw walls, bound at the neck, with a vertical seam with cord or plant strips to prevent it from opening up, reinforced with vertical rods placed 30-40 cm apart and tied with bands of branches to secure them. In both cases the grain store is covered with a conical or pointed bulbous thatched hood, consisting of ten thin branches tied together with three or four more rings of a simple plant cord also used to tie the successive bundles of straw for the roof. This can be removed or replaced easily to store or extract grain when necessary.



Birifor silo in the shape of an enormous mud carboy under a roof. Its mouth springs from the flat roof and is covered by a small thatched conical hood.

Lobi silos integrated into the walls of the dwelling, also providing rigidity.

The silos built with mud walls and raised from the ground are less frequent, but are also very widespread. These are generally raised from the ground on stones and may be cylindrical, parallelepiped, truncated cone or even an inverted truncated cone shape in the form of a large pot. They are usually combined with a thatched hood which can cover the entire roof or be limited to a hole at the top. They can be freestanding, either individually or in groups, or be integrated into the dwelling, slightly standing out above the flat roof.

The grain stores of Labien have a rectangular floor plan and domical vault roof with an upper opening and small thatched hood cover. The grain store is built on a raised base of masonry, beams and intercrossed branches, and the vertical walls are built using adobe or the shaped earth technique as far as the springing of the domical vault, built in most cases with cob. The sides can be over 3 m long and up to 5 or 6 m high, and apart from the crowning oculus, have openings in the façade providing access to the interior. The silos have logs inserted at the top of the walls which are used to climb up, while branches set into the domical vault are used to tie down the hood so that it is not blown away. These silos can be decorated at the base or halfway with human, animal or natural representations.

There are at least three types of silos in the Lobi country. Firstly, the freestanding silos with a square floor plan and truncated pyramid shape covered with a thatched hood, with an opening at the top and on the upper section of one of the

Two freestanding Lobi silos with their respective thatched hoods and access shafts at the top.

Freestanding Gan silo with a thatched hood and a small forked post to facilitate access.

sides to store and extract cereal. These silos are generally built shaping earth, but also with the typical Lobi overlapping cob courses. Secondly, there is also a version of these silos built shaping earth under the roof of the dwelling, where the silo is accessed through the circular mouth above the roof. The silo is integrated into the dwelling but is not structurally linked to its walls. The third type of silo is integrated into the walls of the dwelling and therefore has the characteristic overlapping course walls. These silos with a circular floor plan generally adopt cylindrical or truncated cone shapes in the final section and are then covered with a thatched hood. The silos built into the enclosure of the dwellings act as buttresses to strengthen the walls and have a distinctive polygonal overlapping outline. The spaces between the raised bases of the silos and the built-up dwelling walls are used as chicken coops.

In the Kassena country the silos have a square floor plan and truncated pyramid form or circular floor plan with a truncated cone, in both cases slightly bulbous and covered with small conical thatched hoods. Although they tend to be built in the courtyard, separated from the dwelling walls, there are two forms of raised construction: one with a framework supported on masonry and open on all sides and the other closed to form chicken coops. As with most Kassena constructions, the silo walls are also decorated with designs which can transform this type of common construction into veritable works of art. Just as in the similar silos of the Lobi country, cross-ventilation is guaranteed by the circulation of air from the base or the small windows up to the top opening, to ensure optimum conservation of food.

Freestanding Kassena silo decorated with the same typical geometric motifs as the dwelling.

Old Mossi silo built with termite nest earth.

Turka silo on display at the Museum of Gaoua.

Some older mud Mossi silos, more slender, about 1 m in diameter and 1.5 m high, are built shaping earth and have a single smaller opening at the top, covered with a small thatched hood. Others around Boromo, in the centre of the country, are more modern constructions emulating dwelling huts. They are over 3 m in diameter and the large protective hoods on the roofs, which are raised on masonry, can be clearly distinguished.

A few other exceptional examples rest on rock, like the group of slender vaulted silos at the foot of a crag in Niansogoni, built shaping earth, occasionally supported with interior angle braces to increase rigidity. These silos with side openings at the top have survived well despite direct exposure to rain, as the vaults are partly protected by the rocky wall. There is also another type of store or smaller domestic silo in the shape of large ceramic amphorae.

Group of Dogon rectangular silos perched below the Cliff of Bandiagara in Mali.

Millet stored on a shed and on an open silo consisting of an elevated platform resting on a circular palisade also used to store the cereal stalks.

There are various forms of Dogon silos: with a circular floor plan and truncated cone roof or a square floor plan topped by a cupola and upper thatched hood, and others less frequent, resembling leather bags or earthenware jars. They are used to store food as well as women's belongings and other utensils. They are accessed from above or from the side façade, especially in the silos covered with a thatched hood. Thin internal shaped earth walls often separate the stored elements and strengthen the silo. Branches are also commonly used as internal angle braces at different heights of the silos with square floor plans or as cross diameters in the silos with circular floor plans. The purpose of these branches inserted in the angles in the walls and often protruding out through the exterior surface is two-fold: to be used as a ladder to check and maintain the silo and also to brace these thin mud structures. In the Dogon villages of densely clustered dwellings there are also truncated cone silos in the middle of the dwellings, and these can be divided into two or three heights, irrespective of whether the dwelling has one or two storeys, while interior thin walls compartmentalize the granaries.

In the damper southwest of the country, in Senufo territory, silos are occasionally found open to the elements on a timber platform approximately two metres from the ground, supported by a perimeter log palisade also used to contain the stored millet. In these places cereal can also be found stored on the flat roof of the *patam*. This layout exposed to the elements is probably a response to the higher humidity levels of the climate and the need for ventilation.

Mosques

Sixty percent of the population of Burkina Faso (a little over 12 million inhabitants) identify as Muslim. Most of these belong to the Maliki school within Sunni Islam, which is influenced by Sufism, although the Shiite religion is also represented in the country to some degree. The Muslim population is especially strong in the north, east and west of Burkina Faso.

The mosques in Burkina Faso generally point east, towards Mecca and the rising sun, hardly deviating from the true east. The most common rural mosques are usually rectangular constructions crowned with a cylinder or rectangular prism housing the mihrab. The roof over the mosque nave is gabled or hipped with corrugated sheet metal, while the mihrab has a cupola that is generally quite pointed or stacked with progressively smaller blocks (see the chapter on mosque cupolas). The cupola is usually topped with the half-moon symbol, except in very modest constructions. Sometimes there is a small ventilation opening at the top of the cupola to let hot air out. Not all these more modest mosques have a minaret for the muezzin to call the faithful to prayer; only larger mosques incorporate these characteristic adjacent towers.

The entrance to these mosques is generally on the south side of the rectangular structure, where windows are also incorporated to generate cross-ventilation with the north side. This is needed given the heat generated by the corrugated metal roof exposed to the sun. These windows are often made with precast lattice blocks or with metal slats to provide continuous ventilation to the space, even when not in use.

In addition to these fairly simple country mosques, there are several examples of large Sudanese mosques. Sudanese architecture, or that of western Sudan, found mostly in Mali but with examples in Algeria, Burkina Faso, Ivory Coast, Ghana, Niger or Nigeria, is mostly urban. The monumental architecture uses earth mixed with straw, rice husks and occasionally shea butter to form the adobes or the rendering, with rectangular floor plans, mostly flat roofs and tapered or roughly rounded forms. The interiors generally have no decoration. This architecture features pilasters crowned with pinnacles and, in religious architecture, towers with staggered elements and/or pointed ovoid cupolas. Building walls tend to include logs and branches from local trees inserted and used as permanent scaffolding for regular maintenance with rendering.

The origin of Sudanese architecture is attributed to Abu Ishaq Ibrahim al-Sahili (1290-1346), also known as al-Tuwayjin, an Andalusí master builder and poet from Granada.[88] Sudanese architecture underwent a revival of sorts in the colonial period, when French architects took their inspiration from it for the creation of their buildings, generating what has come to be known as neo-Sudanese architecture. In Burkina Faso there are five famous Sudanese mosques: the ancient mosque of the department of Dori, the three-hundred-year old mosque of Nam-Yimi in Kombissiri, the mosque of Ouahabou, which is

[88] Velázquez Basanta, Fernando Nicolás. 1999. *Un mutanabbi andaluz: vida y obra del poeta, alarife y viajero granadino Abu Ishaq Ibrahim al-Sahilí, alias «al-Tuwayyin»*. Cádiz: Universidad de Cádiz; Pimentel Siles, Manuel. 2008. *El arquitecto de Tombuctú. Es Saheli, el granadino*. Madrid: Umbriel histórica.

Flat roof and tower of the mosque of Bobo-Dioulasso.

Lighting and ventilation oculus in the mosque of Bobo-Dioulasso with a ceramic bell-shaped dome.

at least two hundred years old, the mosque of Bobo-Dioulasso, built between 1880 and 1890, and the recently built Bani mosque.

The ancient rural mosque in the department of Dori has three distinct parts: the courtyard, surrounded by a wall with buttresses rising to form battlements; the nave, higher up, with a perimeter wall marked out with buttresses following the same pattern; while the composition is rounded off with the high truncated cone minaret bristling with stakes to be used for maintenance. There are sometimes straw mats on a lightweight structure of timber posts and beams, creating shaded areas in warmer seasons in the courtyard and provisional shelter from the rain in the rainy season.[89]

[89] Domian 1989, op.cit.: 90.

The mosque of Nam-Yimi in Kombissiri has three increasingly staggered bodies, the first corresponds to the courtyard for ablutions, while the second and the third correspond to the nave crowned by the minaret with the mihrab covered with a pyramidal dome at the back. The three parts are dotted with roughly rounded merlons and lattice on the façades with rough traceries of adobe providing decoration and cross-ventilation on the upper part of the spaces. The pointed pyramid of the cupola also has latticed tracery in adobe. The mosque has multiple accesses on the three sides of the courtyard and the naves.[90]

Ouahabou mosque has an outer wall around the courtyard with earthenware water jars laid out for the ablutions carried out before entering the building. It features beautiful, strongly tapered architecture with pinnacles on the corners and a main conical tower for the mihrab. Unlike many Sudanese mosques, the walls have no reinforcing buttresses and rely solely on their tapered shape for stability. The mosque thus looks simple and unornamented, and the walls are only defined by the roughly rounded merlons, the corner pinnacles and the tower. The pinnacles, especially the tower, bristle with wooden logs and branches used to climb up to carry out maintenance. The tapering of the walls is so pronounced that long external drains are needed to lengthen the overhanging spouts and stop water from running down the wall.

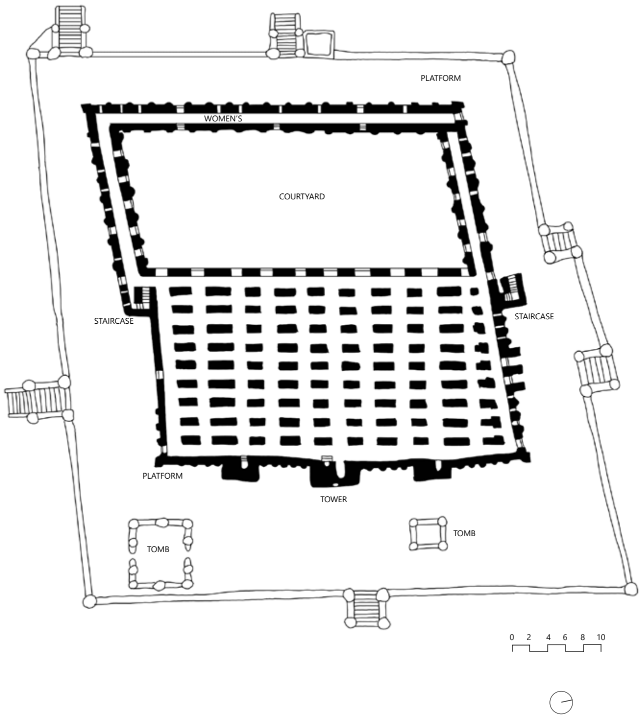
[90] Ago, Fabrizio. 1982. *Moschee in adobe, storia e tipologia nell'Africa Occidentale*. Kappa: Roma.

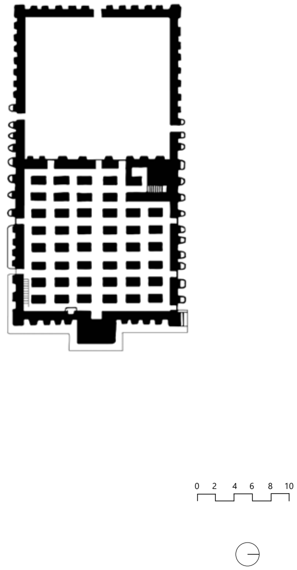
Muslim saint at the foot of the mosque of Bobo-Dioulasso.

Interior view of the mosque of Bobo-Dioulasso.

The main mosque in Bobo-Dioulasso is the Sudanese mosque par excellence in Burkina Faso. Its characteristic walls are marked out with buttresses with pointed pinnacles and by the two upright pointed towers bristling with logs used as steps to provide access for maintenance. The mihrab tower is on the shorter side of the mosque on the main street, while the second tower on the north side incorporates stairs for accessing the roof, to which a second interior staircase on the southeast corner provides access. Inside there is a courtyard and a hypostyle nave with 65 sturdy rectangular pillars supporting the roof structure with lintels and beams pressed together with no gaps. The roof is made of tamped earth with low walls running across to direct the water to the spouts following soft transversal slopes. The mosque can hold up to 800 people, but the first two rows are reserved for elderly women, the following seven rows for men, and the remaining rows are for guests and helpers of the imam. For many years, women were strictly forbidden from entering the mosque. The mosque is built with laterite, adobe blocks and earth mortar occasionally mixed with shea butter. In recent years it has been expanded, occupying part of the historic courtyard with an extension of the hypostyle nave with pillars with three courses of cut laterite blocks at the base and successive courses of adobe rendered with earth mortar. At the same time, work began on the white painted rendering, which has been completely chipped away for renovation. During this intervention, the characteristic buttresses with an extended plinth in the form of an elephant's foot which simultaneously acts as a bench for the faithful and passers-by, have been underpinned or blocked with a laterite base, while adobe has been used for the upper courses or interior, respectively.[91] The government has expressed a wish to obtain a World Heritage listing for this mosque, but this has not yet gone through the official channels.

[91] Domian 1989, op.cit.: 112-117





Floor plan of Djenné mosque in Mali according to Gérard Beaudoin, redrawn by the authors.

Floor plan of the mosque of Bobo-Dioulasso according to Sergio Domian, redrawn by the authors..

Bani mosque is a large mosque built with adobe and rendered in mud in the late 20th century at the initiative of a local resident. It is a two-storey building on a rectangular floor plan crowned at the front with a cylinder marking the position of the mihrab. Its symmetrical façade with central access has a gable with a slight incline and staggered pinnacles. This façade also has simple decoration in bas-relief with perforations and representations of people praying, which is rather uncommon in Islam. The remaining façades have no ornamentation and are defined only by the buttresses crowned with pinnacles and the cylindrical tower bristling with rods used to climb up and carry out maintenance. In a corner of the mosque courtyard the minaret of extremely slender stacked prisms is freestanding. When this mosque was finished, the same developer built eight additional mosques in the village which oddly enough point to the main mosque and not Mecca.

Interior view of a Sunday celebration in a rural church built with precast cement blocks, metal walls and a sheet metal roof.

Churches

About 30% (approximately 6 million inhabitants) of the population of Burkina Faso is Christian, mainly Catholic with only a few Protestants. As Christianity was only introduced very gradually from the late 19th century it has a very short history in Burkina Faso. Therefore, the country has no Christian architectural tradition of its own and the church models have been imported directly from Western tradition and shaped by church doctrine. One clear example is the neo-Gothic Ouagadougou cathedral, built in red brick in 1930, with gabled arches, Florentine Renaissance biforas, rose windows and staggered English-style buttresses. At the opposite end of the spectrum we find the rural churches built on timber posts, open on three sides and roofed with a thatch layer or, more often, with corrugated sheet metal, so that continuous ventilation is guaranteed at the least hint of a breeze.

The same church seen from another angle.

An exception to this is Boni church, in the province of Tuy, in the region of Hauts-Bassins, the capital of which is Bobo-Dioulasso. The entrance to the parish church, built in 1978 by the architect P. Staff Campforts, is in the shape of a mask, a nod to the fact that the village is famous for its Bwa masks. The giant mask at the entrance is 12 m high and represents the ancestors. These masks are generally used in funerals, rain rituals and other festivities, and are mainly used for requesting blessing, fertility and happiness for the people. There is a cross above the mask so that the façade clearly symbolizes the transition from tradition to Christianity, aiming to integrate into the surrounding aesthetics and culture.[92]

[92] Lasagne, Isaac. 2021. "Burkina: Église de Boni, entre tradition et christianisme". *Vox Kultur* 06-07-2021.

Monumental trees such as large baobab trees can be sacred places for the animist religion.

Animist Sacred Buildings

Animism represents between 12% and 15% of the religion of Burkina Faso and is part of the country's cultural tradition. Thus, many enclaves, elements and beliefs are still particularly important in the architectural and natural landscape. It is often not the buildings themselves but places, milestones in the landscape, monumental trees or animals, which emphasize this sacred significance. This is the case of the impressive sacred termite mound in Loaga, 20 kilometres from Kongoussi in the province of Bam, around which the village is built, or of the group of mushroom-shaped termite nests in a wasteland in Timberba which, according to legend, is a squadron of armed soldiers. The sacred baobab of Toumousseni

Crocodiles are sacred animals in Burkina Faso.

View of the fetishes in the courtyard of the sukala or home of the Lobi shaman.

is equally regarded as an example of a sacred tree, while many animals are also considered sacred in their different habitats, including the sacred crocodiles of Sabou, Bazoulé, Dounkou or Diébougou (crocodiles and humans are believed to share the same spirit). Moreover, reservoirs are also considered sacred, as are the sacred ponds of hippopotamuses in Satiri and Padéma, as well as Dafra pond, with its sacred fishes. Turtles are also generally a sign of virtue, happiness and longevity, connecting men and spirits.

Boy playing with the sacred crocodiles in Bazoule Pond.


Group of dwellings or huts belonging to the ancestors of the Gan kings in Obiré.

There is no animist architecture as such, although there are monoliths, altars, sculptures and fetishes which represent transcendence and the sacred. The Lobi consider the Supreme Being so powerful that they cannot communicate directly with it and have thus set up a somewhat intricate system for invocations using several fetishes. For example, the witchdoctor or shaman of a Lobi village has dozens of fetishes representing ancestors outside the dwelling or *sukala*, unnerving figures used to cast spells to grant prosperity to the village or to a particular family.

Furthermore, each family *sukala* has a room for family fetishes, linked through windows with the main fetish, located outside, probably on the terrace, at times even sitting on the roof above

Dabira, one of the ancestors of the Gan kings, in his hut in Obiré.

Bobo altar with blood remains from the most recent sacrifices.

The original house of the Bobo ancestor and founder of Sya, built in the 11th century, in Bobo-Dioulasso.

the access to the dwelling. This fetish on the flat roof in turn transmits the message to a sacred forest (the etymology of the Lobi is "children of the forest"), where another fetish receives and transmits it to a higher-ranking fetish on the top of a mountain, who passes it on to the Supreme Being.

These fetishes are sometimes camouflaged, hidden or buried so that non-believers and traders cannot find them. Spells use smoke, jawbones and cowrie shells, and chicken sacrifices are common. The witchdoctors also use cowrie shells, once used as currency, to predict the future or to help those who consult them to make choices.

Decorated Kassena altar at the entrance to the Royal Court of Tiébélé.

Decorated Kassena altar beside the entrance to a dwelling in the Royal Court of Tiebélé.

The Gan ethnic group has a sanctuary for the Gan kings, where the deceased kings and queens of this tiny kingdom within Burkina Faso have been buried for generations. These statues look like fetishes, with eyes and necklaces made with cowrie shells, and each has its own individual hut. The Gan king is the guardian of these fetishes which are central to their animist religion.[93]

Other elements are the altars and monoliths of offerings of the Bobo ethnic group, which can be simple solid conical structures of earth and stone, held together by chicken blood from the countless sacrifices carried out over the years, sprinkled with feathers and spattered white. The Bobo and other ethnic groups also have houses for these fetishes, like the *Konsa* House, first built in the 11th century, the original dwelling of the Bobo ancestor, founder of Sya and nucleus of the city of Bobo-Dioulasso.

The Senufo, found throughout Burkina Faso, Ivory Coast, Mali and even Ghana, also build sacred houses for the fetishes which protect the people, where the straw roofs are never replaced but every year a new layer of straw is added to the roof. These strange thick roofs which grow over time can even be used to establish the date of construction.

The animist Kassena ethnic group believes that men's behaviour is governed by supernatural forces. Worship can be understood on two scales. At village level, worship is conducted both inside and outside, in watercourses, sacred forests, and hills. For families, worship takes place inside the dwelling, dedicated both to the founder and to all the ancestors in the family lineage. The rites celebrated inside the village or in the dwelling use thick tapered earthen cairn-like altars. The altar of the ancestors who watch over the threshold is a few metres away from the entrance to the concession.[94] Other major elements include the *pourou* or sacred mound where the placentas of family members are buried, sacred stones and the ancestral cemetery.[95]

93 Bognolo, Daniela. 2010. *The Gan of Burkina Faso. Reconstitution of the history and symbolics of a little-known kingdom*. Genève: Fondation Culturelle Musée Barbier-Mueller.

94 CRAterre-ENSAG 2014, op.cit.

95 Wilquin et al. 2022.

Interior of Bobo-Dioulasso mosque, almost resembling an excavated space given the thickness and number of massive adobe pillars and the roof with hundreds of joists close together

7. Architectural Space

Different forms and variants of space and geometry are found within the architecture and culture of the country in terms of territory, urbanism, architecture and detail. This text describes and analyses the central, linear, isotrope, intermediate, exterior, negative, topological, mystical and improvised spaces, as follows.

Central Space

Viewed from a purely geometrical perspective, the concept of single central space is not found in the field of architecture or urbanism in Burkina Faso. However, the focus on the concept of enclosure, both in dwellings and some villages, probably originated in protection from the exterior world, generating central spaces in the form of large courtyards or esplanades surrounded by a tight perimeter of huts or dwellings. This is the case of certain compact settlements of the Kassena (such as the village of Tangasoko), of the Lela (see the case of Ziuma in Poa mentioned earlier) or of the Kusasi. While in Arab Berber culture the courtyard is the centre of the home, in African culture the courtyard is the centre of life.[96] However, this centrality, which is more conceptual than geometrical, does not seek to focus space on a milestone or object, but rather generates a shared space emanating from a central inward-looking protected enclosure. There are also examples of radial geometry in the crop fields in the south of the country around the settlement, where ridges are organized in concentric polygons and, for practical reasons, the access paths from the dwellings have a radial layout.

However, in the case of smaller-scale architecture some spaces can be described as central. These include the Dogon houses of the word or *toguna*, with a square floor plan open on all sides, which are also central to village legislation. This is not merely in terms of geometry as concentrated decision-making power emanates from here. Although simpler and more functional given their role as pens or hayricks, the simple *patam* with four posts can also be viewed as central when used as a canopy to receive the authority of the *naaba*.

[96] Fassassi, Masudi Alabi. 1997. *L'architecture en Afrique noire. Cosmoarchitecture*. Paris: L'Harmattan: 55.

Central space. Radial geometries of the crop fields around the human settlement forming the centre.

Central space. Thatched conical roofs widely found in traditional architecture throughout the country. They cover circular huts, silos or the mouths of the domes of the giant carboy-shaped grain stores, creating radial geometries and highlighting the specific weight of the centre.

In the case of Peul huts, especially the larger ones, which are usually independent and have no partition walls, the focal point of the single central space is normally the multi-forked central post on which the radial branches of the structure rest. Although it could be argued that the mud huts with a circular floor plan built by many other ethnic groups in Burkina Faso appear to create a similar space, this is not so. Factors such as lesser size, internal distribution, creation of niches and platforms, skylights in the kitchen generating alternative foci or the absence of a conical roof in some cases prevent the emphasis on central space that one might expect from a circular floor plan. There are some other examples of radial geometry similar to that characterizing basket-weaving, but found on a different scale in the Peul huts, answering the implicit need to generate a circular form.

Central space. The toguna of the Dogon villages and similar structures are central in geometrical, symbolic and legislative terms, as they are the centres for decision-making in the village.

Linear space. Linearity is highly present in Burkina Faso through the seemingly endless communication routes spread over the savanna plains, with a handful of natural or geographical features.

Linear space. Linear geometries generated by the furrows and ridges of crop fields.

Linear Space

Linear space in Burkina Faso is more closely linked to territory than to architecture. The communications between villages and towns, along dirt tracks where people often go on foot or occasionally by bicycle rather than drive, transform these transport links into conscious moving vectors within a linear space. Major rivers also contribute to a feeling of dynamic and fluid linear space. There are some avenues of trees planted in colonial times by the French, who were also responsible for the clear lineal geometry of dug-out trenches or caves, such as those in the city of Diébougou.

Linear space. The avenues and rows of trees planted by the French in colonial times highlight this characteristic linear geometry of road communications.

Agriculture sometimes generates linear geometry in the form of ridges and the furrows between them, found in some fields in the south of the country, although other forms of cultivation create small earth mounds, one for each plant, generating a different type of isotrope geometry. On a domestic scale, architectural elements such as Y-shaped notched log ladders, vertical posts or beams with a linear profile do not automatically generate architectural spaces. Only some groups or ethnic groups build hallways or long corridors leading on to the different quarters or rooms in dwellings. An example of this is the *zapo* or entrance hallway in a Puguli dwelling, which is designed as a linear space progressively leading to the different rooms.

Isotrope space. Cultivation system using earth mounds in an isotrope grid to improve absorption capacity for the water available.

Isotrope space. The large shelters, which can have up to 7 posts per side, generate an internal hypostyle space with 49 posts highlighting their modular and isotrope nature.

Isotrope Space

Hypostyle space, that is, space supported by columns, is frequently found in Burkina Faso. This space is generally isotrope, with no single dominant compositional axis, and is found in the sheds, *patam* or *zandé* of vernacular architecture, where the thin 15-20 cm diameter posts barely interfere with the view or the space covered by the shed. The larger *patams* or *zandés* are more clearly hypostyle, and the *zanpabré* in particular can have up to 7 pillars per side, totalling 49 timber posts.

The provisional structures of very large markets, organized in much the same way as the *patam*, similarly follow the hypostyle space scheme. While church buildings are usually characterized by their elongated basilica layouts, in rural areas some are improvised with a hypostyle structure and corrugated metal roofing.

A hypostyle –and also to some extent, isotrope– space or one that is equal in all directions is found in the interior of Sudanese mosques, dotted with thick adobe pillars to form a characteristic grid. In the mosque of Bobo-Dioulasso, these pillars have a rectangular section, with sides measuring 1 × 1.6 m, so that the isotropy is not complete, as the columns follow a predominant direction. The relationship between the thickness of the supporting pillars and the resulting space, similar in size to the

In-between space. In Burkina Faso there is an abundance of in-between spaces, halfway between the interior of the dwelling and the exterior with the elements. These are usually generated with shelters, branch structures, mats, pergolas, etc.

pillars, is reminiscent of the colonnade or paradiso space of the Danteum (1938) designed by the architects Giuseppe Terragni (1904-1943) and Pietro Lingeri (1894-1968), which appears to have been inspired by these hypostyle naves in Sudanese mosques.

In-Between Space

In-between space is a crossroads space between two elements which can establish a reciprocal relationship, generally one between exterior and interior space, although it can also be interpreted as a crossroads between public and private spheres, between the functions of trade and housing, or between means such as

In-between space. Bobo woman preparing food in the in-between space of her urban porch, which protects her from the sun with better temperature conditions while still allowing her to enjoy the outside breeze and continuous ventilation.

In-between space. Kassena man taking a nap on a low ledge under a porch which is a prolongation of the roof.

water and earth.[97] The architecture of all the cultures and ethnic groups in Burkina Faso provides numerous examples of interior/exterior in-between spaces. Interior/exterior spaces are partially outdoors but partially protected in some way by a porch, a shed or *patam*, a small roof, a mat, a wall, etc. They are an extension to the outside of the dwelling or the building where sociocultural relationships frequently occur. They act as a sort of threshold to the building, spreading out to create an added room. These are porches, spaces under eaves in overhangs or mats, sheds, courtyards, etc. Woven mats, palisades and latticed walls also contribute to the creation of this type of space. Nature also generates in-between spaces: a clear example is that of a large leafy tree creating a shaded space at its feet that is different from an exterior space exposed to the sun. The custom of piling straw over the tops of deciduous trees as if they were hayricks for storage also creates an in-between space at the foot of the tree. In a warm climate like that of Burkina Faso they also play a vital role in reducing ambient temperature by several degrees, as well as offering protection from the direct incidence of the sun. The huts of the Gan, for example, prolong the thatched roof to a porch, where the greater part of family life takes place, especially when the sun is blazing.

In many of the villages, settlements and dwellings of Burkina Faso, the in-between space of the dwelling takes material form in courtyards: the communal courtyard of the family settlement and private courtyards belonging to the different wives of the family chief. Sometimes these in-between spaces in courtyard form also act as a subtle grading of the various in-between spaces between the private and public spheres. Minor elements and signs, sometimes only perceived by the inhabitants, mark signals on the successive borders of private space: a break in the distribution, a corridor, a low wall, a platform, etc. Dark rooms lit with vertical skylights, halfway between the exterior sun and the interior shade, between light and darkness, could also be included within this category of the many forms of in-between spaces.

Several of the most famous architects working in the country have consciously incorporated these in-between spaces into their designs for contemporary public buildings. Aware of the wealth of sociocultural relations which take place in these transitional spaces and the bioclimatic advantages, they have added courtyards (Lycée Schorge by Francis D. Kéré), porches (Laafi Nursery School in Koudougou by Albert Faus), generous eaves (Dano School by Francis D. Kéré, the orphanage in Koudougou by Albert Faus), masonry lattices or latticed walls (Laafi Nursery School in Koudougou by Albert Faus), palisades (Lycée Schorge by Francis D. Kéré), semi-open courtyards (Dano School by Francis D. Kéré), etc.

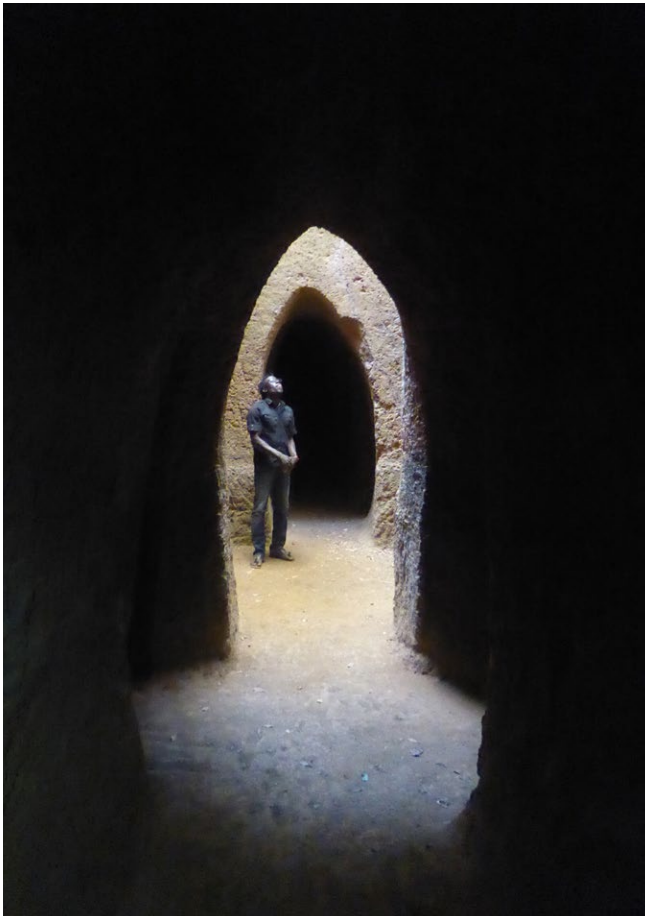
[97] Vegas, Fernando; Mileto, Camilla; Songel, Juan María; Noguera Giménez, Juan Francisco. 2014. "In-between spaces, borderline places". In Correia, Marina; Dipasquale, Letizia; Mecca, Saverio. 2014. *Versus. Heritage for tomorrow. Vernacular Heritage for Sustainable Architecture*. Firenze: Firenze University Press: 186-196.

Exterior space. Mossi woman walking in the open landscape of the savanna dotted with dispersed trees and a lagoon on the horizon.

Exterior Space

Almost all over Burkina Faso, exterior space consists of an extensive plain of savanna with small shrubs occasionally dotted by individual trees, which become the only tangible points of reference on the horizon. This space is for the most part inhospitable, with inclement sun and wind and rain exposure. Though essential for movement, work, cultivation and collection, it is unsuited to living. It is mainly brown, but briefly shifts to green after the rainy season. The exterior space changes, especially in the south of the country: the orography ripples, closing

Exterior space. The sordid and inhospitable exterior of savanna regions fully exposed to sun, wind and rain, without shelter.



Negative space. Caves of Diébougou excavated in French colonial times for defensive purposes, with tunnels with parabolic and pointed sections and intermittent light openings.

off the perspective, geological milestones are created in the landscape, and the vegetation becomes so thick that the horizon is limited to a few metres, creating uncertainty and mystery behind the dense green mass of trees and plants.

Negative Space

Among the examples of excavated architecture, widespread spaces dug out from the earth and not the result of additions, it is especially worth mentioning the military caves from colonial times such as those in Kampti, Gaoua,

Negative space. Open-pit mine near Bobo-Dioulasso.

Negative space. One of the many gold mines scattered throughout the country, dug out for wells and occasionally galleries in search of this precious mineral.

Negative space. A miner woman sifting the earth for gold nuggets near Kaya.

Gbomblora, Nako, Batie, Kpétobo, Bamako (Burkina Faso), Dano…,[98] particularly the impressive military cave tunnels of Diébougou. Apparently excavated before or during the First World War using forced labour, these include a major network of corridors, hallways, niches, bedrooms and trenches forming a monumental complex of great interest. There are pointed, parabolic and pointed horseshoe vaults and arches in search of optimum structural form. Nowadays they provide refuge to colonies of

[98] Da, Inyinibon & Somé, Magloire. 2014. "Les grottes naturelles et militaires dans l'histoire des peuples du Sud-Oest du Burkina Faso" in Somé, Magloire & Simporé, Lassina (eds.). 2014. *Lieux de mémoire, patrimoine et histoire en Afrique de l'Ouest: Aux origines des ruines de Loropéni, Burkina Faso*. Paris: Éditions des archives contemporaines: 243-261

Negative space. Senufo woman drawing water from a traditional well dug into the ground with its cob parapet.

bats and some crocodiles from the nearby dam, which hibernate there in periods of extreme drought.

Beyond the domestic sphere, excavation for water wells or mining in general, especially gold mining, also plays a major part in the life of many inhabitants who struggle in poverty hoping to strike gold. The gold-producing regions of the country are riddled with deep narrow wells accessed by elbowing down against the walls. The men who enter these wells in search of the precious mineral have a rope tied around their waist like an umbilical cord, connecting them to the exterior and signalling their co-workers on the surface to air the mouth of the well so that the air can reach them and enable them to breathe. On the surface, other men and women sieve or winnow the aggregate extracted searching for gold grain.

There are also abundant natural caves, especially in the rocky formations of the southwest with Niansogoni as a famous point of reference or in the cliffs of Gobnangou in the east, which were used as shelters from foreign enemies for many centuries even in colonial times. A Birifor legend explains how, in antiquity, an animal known as the *toulintour*, probably an aardvark, dug out tunnels and burrows later occupied by other animals and human beings in time of danger.[99] Geology explains the existence of these caves brought about by wind erosion and the mechanical action of water. Some of these caves are small, while others are larger and were commonly used for refuge in this part of the continent. It is worth recalling the nearby example of the Cliff of Bandiagara in Mali, whose caves have consecutively provided shelter to different peoples, starting with the Andoumboulou and including the Tellem and Kourouma right through to the Dogon peoples who currently live there.

Topological Space

Topological space is one with no defining axes. It is organic, apparently disordered and chaotic, dynamic and continuous, tactile, with no edges, angles or interruptions so that objects are perceived in succession, following a route that is felt rather than seen. Euclidean space is based on the concepts of direction, orientation, size and situation while topological space is based on proximity, separation, order, envelopment and continuity. Never-ending fluid forms, with soft and delicate transitions, are simultaneously translated into fluid space.

The most ancestral or primitive vernacular architecture anywhere in the world, almost hand-moulded, often seems to respond to this type of topological space, in many ways close to the idea of a baby's space in the mother's womb or in the first months of life. In Burkina Faso this type of topological space can be found both in dug-out architecture, that is, natural or excavated caves where this functional continuity of surfaces is almost natural, and in architecture created through addition. This is particularly true in the case of architecture built with shaped earth or cob techniques, where handmade qualities like those found in ceramics mould architecture just like large vessels containing living space, which is what they really are. The ceramic kilns

[99] Ibidem

Topological space. In Kassena architecture the combination of fluid forms and the effect of the abstract paintings with geometrical motifs blurring the outlines of the volumes give rise to very intense topological spaces.

of the Lobi, for example, are a masterclass in rounded surfaces, vaults and domes designed in continuity. In this topological architecture it is common for the notions of ground and ceiling, bench and wall, wardrobe and room, niche and bed, or platform and step, etc. to converge.

In fact, the interiors of many of the mud huts built by the different ethnic groups are characterized by these continuous surfaces which even avoid abrupt encounters, with edges softened to generate natural earthen forms. The platforms and benches by the door seem

Topological space. Man and woman near Kaya in a strange perspective due to the lack of references in the extensive landscape.

Topological space. The extensive flat roofs of Birifor dwellings merge with the surrounding terrain.

to be a simple natural thickening of the walls while, in turn, the niches are natural thinning; the steps appear to be dug out from the terrain; the windows with no edges seem like natural openings; the drainage spouts are gaps in the wall; some rooms take the form of excavated niches; and at the same time the extensive flat roofs of Birifor dwellings merge with the terrain itself... Kassena architecture is particularly close to this concept of topological space, with earthen steps integrated into the construction to provide access to the roofs, and the geometric motifs of abstract paintings which blur forms, contours and distances, to the point of dematerializing the architecture. On occasion, as in the case of the walls with overlapping profiled cob courses of the Lobi, Puguli and Birifor, with their undulating outline of curved angles providing greater inertia and resistance, this characteristic fluidity of topological space comes to be synonymous with the visual dynamics of the architecture which captivates visitors.

Mystical Space

Mystical space, understood not necessarily as a space for sacred architecture, but as a place which makes it possible to transcend everyday life, is also present in the daily life of the peoples of Burkina Faso. Religious buildings, whether Christian temples or mosques, are mystical from the outset given their roles as intermediaries with the highest divinity. The enclosures or courtyards with large rounded stones, fetishes or sacred phalluses have a deeply spiritual aura emanating from these sacred milestones, which can go unnoticed by visitors while being very clear to the inhabitants.

However, some architectural elements or domestic details generally related to the entry of light into the dwelling express mysticism without seeking it. This is the case with the skylights or light oculi created by inserting bottomless ceramic pots in the flat roofs, generally above domestic workspaces such as the kitchen. The blinding daylight slipping down the oculi in the roof or even penetrating through the access doors appears as some sort of mystical revelation in the dimly-lit huts with their dark rendering while warning of threats from the exterior. These oculi are covered with bowls or ceramic hoods to prevent heavy rain from falling inside, temporarily losing the mystic halo of the intense ray of light which previously broke into the intimacy of the dwelling, providing light and divine revelation.

Mystical space. The light which slides from the zenith and the opening of the flat roof into the dwelling and the hanging vessels seem reminiscent of a divine revelation.

Francis D. Kéré has deliberately taken advantage of this construction detail and the almost magical zenithal light found in traditional domestic architecture, reflecting it in some of his buildings, such as Gando Public Library. This

Mystical space. The zenithal light of the openings over the kitchen bench of the interiors rendered in dark hues in Kassena dwellings confers an almost sacred aura to the objects it lights up.

Improvised space. Peul shelter improvised to some extent with a few skilfully placed mats, allowing ventilation from above.

building incorporates an elliptical floor plan laid across a rectangular layout, a composition reminiscent of some of the 1980s designs by Japanese architect Tadao Ando (1941). The elliptical space is dotted with dozens of skylights, open ceramic pots in three different diameters embedded into the concrete slab of the roof. It refers in some way to the libraries illuminated by zenithal skylights designed by the architect Alvar Aalto. Nevertheless, while the interior space dotted in lights of different diameters is very appealing, the many skylights and the simultaneous opening of large perimeter windows in the ellipse erase the mystical influence of individual skylights in the characteristic darkness of traditional huts.

Improvised space. Mining camp improvised with sticks, stones, mats, canvases and tarpaulins. Here, improvisation is applied not just to the shelter, but also to the urbanism of the entire settlement.

Improvised Space

It is not unusual to find improvised shelters throughout the country. These are spaces created instantly, even using mats to improvise roofs and to vault the interior space, while flat roofs can be built using different mats or a series of bundles of straw on top of posts. The mats on the roof are often raised in relation to the mats of the perimeter, creating a perimeter opening at the top of the enclosure and allowing wind to circulate. Another option is to leave an opening in the upper mat for the same purpose. This type of improvised space, the result of the characteristic ingenuity and manual skill of the local inhabitants, makes it possible to expand spaces by adding adjoining elements to dwellings or enclosures. This includes adding semi-open classrooms to an existing school, creating bus stops that are shielded from sun and wind, or providing shelter for travelling salesmen alongside paths or roads. Sometimes, these are simply roofless enclosures made up of a perimeter of mats and exposed to the elements.

Some nomadic ethnic groups or ethnic groups following nomadic tradition specialize in the creation of this type of improvised space. This is the case of the Peul and the Tuareg who are able to set up a settlement or camp in a very short period of time using their straw huts or canvas tents. However, this skill is equally found throughout the country, especially among the widespread Mossi ethnic group.

In this chapter it should be mentioned that shantytowns are also found in Burkina Faso. These constructions built with industrial or modern materials are usually located outside cities or in provisional camps, although this phenomenon is increasingly spreading, even to rural areas by the roadside. These shacks are improvised with corrugated metal, cardboard, plastic, felt, bags, synthetic raffia canvas, etc. They are often combined with traditional materials such as timber posts used to build the supporting structure and roof, straw mats to enclose the perimeter or cover the shack, cord to tie the resulting structure together or improvise guy ropes, stones to weigh down the roof, underpin the mats or counterweight the cords. When the shacks are intended for more permanent use they can be assembled on a concrete base or combined with walls or volumes built with earth adobe. Alongside them it is possible to find metal barrels or plastic containers to collect drinking water, wooden boards on sacks of earth used as benches, plastic chairs and piles of rubbish produced by the inhabitants.

Improvised camp near Bamako, Diébougou department, Bougouriba province.

Mining camps are a good example of clusters of this sort of improvised domestic space. These are real shantytowns which house gold diggers, even forming urban layouts. They are improvised near gold mines, vertical perforations burrowing deep into the earth, and they last for as long as there are gold nuggets or the hope of finding them. Improvisation of this architecture based on ephemeral or industrial materials and the accidental and transient nature of these urban settlements go hand-in-hand with the impermanent nature of life in these enclaves, where death is more frequent than usual, due to the lack of oxygen at the bottom of the pits, mine collapses, alcohol or violence.

Gan yard and chicken run near Loropeni.

8. Architectural elements

This chapter describes the elements which make up vernacular architecture and the constructive materials and techniques used. These elements are courtyards, walls, foundations, pillars, floors and ceilings, flat roofs, roofs, ladders, stairs, steps, vaults and domes, openings, solar filters, rendering, furniture, household goods and decoration. Some modern constructive materials and techniques have also been mentioned, given their eruption or already widespread presence in the country's architectural heritage.

Courtyards

Courtyards are omnipresent in the traditional architecture of Burkina Faso, either in the form of open interior courtyards in the enclosure, yards, impluvia, ventilation shafts, esplanades opposite huts or communal open air spaces in the village. Their configuration depends on the climate, as well as on the culture of the individual ethnic groups, their historic relationship with neighbours, conflicts, etc. There are open esplanades, fenced ones which belong to the whole settlement, and veritable family courtyards where a large part of daily life and many of the daily activities and family social relations take place. Weather permitting, women use the courtyards to prepare and cook food, wash dishes, store wood for immediate use, take care of their babies, clean and comb their toddlers, rest and talk to women friends. Young children play in the domestic shelter of the courtyards, with the farm animals, especially the chickens, rushing about them. To a lesser extent, men also use the courtyards to share family moments or to talk to other men. In fact, it is extremely common for the houses to have two kitchens with clay trivets to set pots securely on the fire, one inside and the other outside in the courtyard.

In all these cultures a courtyard is synonymous with safety, inspiring occupants with the feeling of shelter, closeness and domesticity which transcends the physical configuration of the place. These courtyards do not follow a set geometry. Their shape tends to be imprecise and the result of the gaps and intervals between huts, sometimes scattered and sometimes connected with high or low walls which form the space. It is odd to think that the most important part of the home is not the result of a specific design, but is rather a residual form arising from constructions. In the Kassena culture, as well as some others, the courtyard can be equipped with raised platforms safe from the rain and mud,

Lobi woman working in the courtyard opposite the entrance to her dwelling.

steps, buttresses, ledges, trivets and altars, as well as steps, furniture for seating, mortars and fermenting pots, hanging clothes, earthenware pots, baskets, etc.

In cultures with front courtyards or courtyards surrounded by room-huts, the courtyard also becomes the extended threshold of the dwelling, which can be viewed as a semi-public or semi-private space, and allows the gradual filtering from the public exterior to the most intimate interior of the huts. Strangers will be allowed access to a courtyard far more readily than to the inside of the huts. In the cultures with front courtyards and small courtyards dug out from the compact mass of the dwellings, like those of

Gathering of neighbours and friends in the courtyard of a Kassena dwelling.

the Lobi, Birifor and Puguli ethnic groups, access to smaller interior courtyards is dependent on previous permission to enter the dwelling.

In the courtyards surrounded by the room-huts of a dwelling, courtyards are imaginatively adapted to the residual space, taking advantage of corners and the occasional irregularities in order to introduce different functions. On the open esplanades between independent huts, as in Gan villages, the borders of domestic courtyards shared by the settlement are invisible and the space meanders between the cabins with thatched hoods and their circular floor plan which seems to emphasize the fluidity of the surroundings.

Mossi woman grinding grain in her jard

Walls

Three main constructive techniques are used in the architectural tradition of Burkina Faso: shaped earth walls, where the earth paste is applied directly by hand for construction; woven walls, using braided plant materials; and masonry walls, first prepared or manufactured with pieces of earth, stone or other types of blocks.

Shaped earth walls

In this technique, earth is placed in a plastic state in successive layers which are then hand-shaped without resorting to any sort of formwork or mould. As shaping earth is closely linked to pottery, its names are linked to pottery techniques. The damp earth is kneaded, often mixed with straw and allowed to rest for some time prior to construction. It is also common to incorporate some sort of plant or animal additive into this mix to increase resistance. The Kassena, for example, build their shaped earth walls mixing the clay with plant fibres and cow dung,[100] but they are not the only people to do so. Local Mossi pottery also resorts to the use of animal dung during the shaping process. In Burkina Faso, the earth has a relatively high laterite content which, according to local tradition, helps it to harden while setting. On the odd occasion, the earth from termite nests is used as this mix of earth, saliva and termite excrement guarantees hardness and resistance. This mass in plastic state is added while the wall is being shaped by hand. The constructions in thin shaped earth walls tend

Construction of a cob wall.

Preparation of the clay balls to be used in a cob construction.

[100]Wilquin et al. 2022.

The task of making pottery without a wheel is similar to the construction of cob walls.

to be curved, oval, or incorporate frequent twists to guarantee greater inertia and resistance in the walls. They are used both to build dwellings and silos and to fence the dwelling enclosure.

The difference between the technique of shaping the earth for thin walls or even for walls with overlapping cob courses, very characteristic of traditional architecture in Burkina Faso, and the technique of stacked earth balls or pitched earth walls of a cob wall is essentially the building process and the thickness. In the case of the stacked earth technique, builders can climb onto the crowning of the wall as the earth, which will fulfil a structural function, is being moulded. It should also be remembered that in general the shaped earth technique uses more water and is more plastic than the stacked earth technique, although in each case this depends on the type of local earth used.

Shaped earth with rolls. As with pottery, the earth is added to the wall in the form of rolls, coils or cylinders in horizontal tapered courses in the same way a potter would have done prior to the invention of the potter's wheel The resulting walls, often tapered, are 20 cm thick at the base, 10-15 cm at the crown and sometimes even thinner in silos. In some instances these shaped earth walls are built up on one or two adobe courses in stretcher bond.[101] These are used to build dwelling enclosures as well as interior partition walls, grain stores, silos, etc. This format is also used in the constructions of some cupolas, especially for bread ovens and grain stores. In principle, they have no load-bearing capacity beyond their own weight or may support small loads like those of a small roof or grain store cupola. In dwellings, the beams of the horizontal structure normally rest on posts with forked ends inside the dwelling next to the enclosure.

[101] Kéré, Basile. 1995. *Architecture et cultures constructives du Burkina Faso*. Villefontaine, France: CRATerre-EAG: 14.

Tapering walls with overlapping profiled courses in a Lobi dwelling.

Wall in overlapping cob courses. The earth is added in the form of kneaded balls which are shaped by hand forming successively overlapping inverted V-shaped courses. These straddling courses can take on the form of rolls of fat or can result in a smooth uniform surface throughout. Irrespective of the previous option, walls can be vertical or tapered depending on each individual case. The common characteristic is that the horizontal lines of the courses are perfectly marked on the outside, unlike shaped earth with rolls. The straddling of the wall section, which provides better joints at the top, combined with the typical outlines of undulating or polygonal

Wall with overlapping profiled courses and buttresses to provide stability in a Birifor construction.

Wall of a Kassena dwelling with buttresses.

floor plans, produces greater resistance. The first course is usually 25-35 cm thick and 50-60 cm high. In the case of the tapered walls, the rest of the courses gradually decrease in thickness to 15 cm on the crown, while the vertical walls are more or less constantly thick from the second course on. From the second course up, the thickness in the remaining courses varies between 15 and 30 cm. In dwellings in the Lobi, Puguli, Dagara or Birifor countries there are usually about seven of these overlapping courses.

These walls are not initially designed as load-bearing, as it is the forked head posts which support the roof beams. However, it is not uncommon to find external buttresses in the form of thicker walls on which to rest the floor beams. The sinuous outline of the horizontal courses around these protrusions further adds to the rare beauty of these walls, with their curved or polygonal outlines. Inside, the shade provided by the pillars beside the wall etches a beautiful staggered profile on the overlapping course wall. Another perhaps less common option is to thicken the wall inside to act as support for joists, leaving the intermediate spaces to be used for storage.

Wall construction

Clay lump walls. These walls are made up of cob lumps or ovoid balls in damp clay shaped by hand and freshly laid in alternating courses in a herringbone pattern. As they are freshly laid, no mortar of any sort is required for settlement or adherence. These constructions differ from

Wall of clay balls built without mortar as they are applied while still fresh.

Adobe construction bonded with clay mortar.

shaped earth and stacked earth walls, also built by hand with clay lumps or balls, because the latter are not handled, flattened or piled on the wall to become a monolithic mass, but their form can still be distinguished in the wall once it has been built. This is a very primitive technique for immediate construction as the clay lumps are not shaped or modelled, just individually bonded. This technique is rarely seen nowadays, but is occasionally used for the construction of small auxiliary buildings or houses for fetishes. These clay lump constructions are often left bare, in keeping with the immediacy of their production and execution.

Adobe walls. The adobe blocks are formed using rectangular wooden moulds, into which a damp mix of earth and straw or rice husk is introduced and left to macerate.[102] The pieces are left to dry in the sun for over a week and then used straight away or stored for possible repairs. The mortar is produced with the same earth used to make the pieces. The walls tend to be in stretcher bond, occasionally reinforced with some small perpendicular low walls acting as buttresses, like the trunk of the cotton tree (*Ceiba pentandra* L.), which spreads out over the ground to guarantee suitable settling and stability. Nevertheless, adobe constructions are also found in header bond.

[102] Beaudoin 1998, op.cit.: 103.

Rectangular hut under construction beside a circular hut in a Gan village.

The general building process consists in clearing the ground, outlining the limits of the wall to be built and pouring water over the outline to reduce the suction effect and allow greater adherence. A layer of mortar is then added and the adobe pieces laid without building foundations. In the few cases where there are foundations, these take the form of a ditch 30 cm deep filled with a layer of sand or gravel or sometimes directly with the first layer of mortar. The wall thickness built using adobe pieces can reach 50 or 60 cm which, thanks to its good resistance to earth compression, can act as load-bearing structures.

Construction of a dwelling with adobe.

Mixed cob and adobe wall in the Royal Court of Tiébélé.

Some variants, such as adobe walls with head joints and bed joints are so thick that they could be described as a hybrid between cob walls and adobe walls. This is seen especially in adobe constructions in header bond, saving on the use of adobe in walls requiring numerous pieces. These walls, which could be described as transition walls, simply reflect the progressive abandonment of cob walls moving towards the adoption of adobe walls and also affecting the floor plan of the dwelling, which gradually changes its curved profile in favour of rectangular shapes. This transition is very clear for example in the current constructions of the Kassena.

Laterite masonry wall in Loropeni.

Lateritic cut block walls. Laterite soil, which is very common in the country, makes it possible to cut and extract very hard blocks which can be bonded directly in construction. Laterite, widespread in the warmer regions of the world, is poor in silica and has a high content in iron, aluminium and other minerals. Geologically it is considered earth, even if its hardness and consistency are similar to those of stone. Its traditional extraction is similar to stone quarrying, using pickaxes, chisels, wedges, saws, etc. A variant of laterite, called plinthite, which reacts to air exposure, is

Low wall with granite stone in the foreground and a wall with lateritic cut blocks and different bonds framed by the concrete portico in the background.

especially common in Burkina Faso. Although plinthite blocks are brittle and soluble in water, upon extraction and after months of exposure to air they become as hard as stone.[103]

[103] Houben, Hugo & Guillaud, Hubert, 2006. *Traité de construction en terre*. Marseille: Parenthèses: 171; Houben, Hugo & Guillaud, Hubert. 2008. *Earth Construction. A Comprehensive Guide*. London: Intermediate Technology Publications Ltd: 173.

Originally laterite was extracted roughly, in the form of irregular stones, and used in that form, generally bonded with earthen mortar for walls or enclosures, but only in places where the material was readily accessible. The most notable example is that of the tapered walls of Loropeni, built with laterite masonry and rendered in a very resistant earthen mortar which has guaranteed its survival for almost a thousand years.[104] Not too far from there, the Gan ethnic group occasionally uses laterite masonry, rendered in earth, to build their huts or the sanctuary of the Gan kings. Even in quarry regions, it is earth rather than laterite that has been used in traditional dwellings. Laterite is also used in the form of rough masonry at the base of silos or grain stores, at the bottom of water courses or verges or as protective crowning for earthen walls.

These lateritic cut blocks can be found perfectly sawn in recent constructions rendered in cement mortar: public plinths or platforms, enclosure walls or building enclosures between concrete pillars, etc. In this case it is often found in infill or roof sections with ingenious inclined bonds in herringbone or chequerboard, increasing their decorative potential while reducing their tectonic character. They have occasionally been used to restore the eroded base of adobe buildings, as well as to double the springing of the adobe buttresses of the Bobo-Dioulasso mosque, rendered in lime mortar, seeking greater compatibility with the original construction.

Compressed earth block walls. These blocks, often abbreviated to CEBs, are made of a mix of earth and a small proportion of stabilizer (air lime, hydraulic lime, cement or clay), compressed in a mould using a mechanical or hydraulic press. The static compression applied expels the air to produce a brick substitute with a density of between 1,700 and 2,300 kg/m^3 with no need for firing. This technique was invented in the 1950s at the *Centro Iberoamericano de la Vivienda* in the course of a search for an inexpensive constructive material. Its use, mixed with cement, is now highly widespread, especially in contemporary cooperation architecture in developing countries. In Burkina Faso there is at least one local manufacturer of CEBs supplying the entire country. CEBs are found mainly in public buildings such as markets, schools and nurseries built in the last thirty years with the help of exterior cooperation grants. This

Construction of walls with compressed earth blocks reinforced with rebars in joints and jambs.

[104] Somé, Magloire & Simporé, Lassina (eds.). 2014. *Lieux de mémoire, patrimoine et histoire en Afrique de l'Ouest: Aux origines des ruines de Loropéni, Burkina Faso*. Paris: Éditions des archives contemporaines.

Wall in laterite masonry and wall in precast concrete blocks.

success is due to the widespread acceptance from the population of the use of CEBs as an improved adobe which works almost like a brick or laterite block. The mortar used in bonding a CEB construction is usually cement mortar, occasionally mixed with aggregate or local earth, which makes the colour a deeper ochre.

Stone masonry walls. Stone is often confused with laterite, which is more frequently used throughout the country, except in granitic zones where masonry takes on colours and characteristics typical of granite. There are some stone masonry constructions, where stone is available, in auxiliary forms similar to those described for laterite masonry, as bases for silos or grain stores, to separate functions in areas of land, etc., but never for large-scale construction.

Prefabricated cement block walls. Cement is a product of the worldwide globalization of materials and techniques, something which occurs even at local level. It is rare to encounter villages or towns with no buildings incorporating this material, sometimes paid for by non-governmental organizations or foreign aid.

Woven straw mats ready for use in construction.

In visual, material and perceptive terms the presence of cement normally seems alien to the surrounding built landscape. The consumption of cement, both in blocks and mortar, is more costly in terms of energy and pollution than the materials used in traditional earthen constructions, extracted from near the site and only requiring the energy of the workers building the wall.

Woven walls

The traditional production of interwoven straw mats or mats made up of bound reeds is widespread across almost the whole country. Combined with auxiliary timber structures or bundles of branches, both vertical and horizontal, these mats serve numerous purposes: they are used for the construction of communal dwellings for the Peul people; to form the drum bases and walls of the Mossi cylindrical or concave grain

Provisional thatched hut built with woven straw mats.

stores; for the creation of improvised huts and sheds (both parallelepiped and vaulted); to establish filters or to generate shade, retaining water to prevent erosion and help reconstitute soils.

These mats are manufactured by spreading the very dry straw from the savanna to form bundles of the same length, bound together with strips in the material 20 cm from the end and successively intercrossing the bundles. The strip is only added at one end while the other is interwoven. The end with no strip is not cut or trimmed. These mats always require a minimal auxiliary structure, with timber uprights to support them vertically or horizontally, either with branches for staves or creepers as straps to build the cylindrical grain stores. The common reed or giant reed mats placed parallel with two or more strips are also tied up and spread out on the ground. In both cases, at least in the case of the Mossi, this work is traditionally carried out by men or by unmarried women with no sons.

Holes made in the ground for the foundation of the wooden posts.

Foundations

Specific foundations are not used in traditional constructions, which are built directly from the ground once they have been outlined on it. However, precautions are taken not to build homes on low ground or floodable areas in order to avoid problems in the rainy season. Before starting to shape or bond the walls, water is poured on the ground to prevent excessive suction and improve adherence.

Very occasionally, traditional adobe walls or walls with overlapping profiled cob courses in the Lobi country have a continuous foundation in the form of a shallow ditch the same width as the first course of the wall, which is filled with a bed of mortar or with gravel, sand or compacted lateritic soil. This is more aimed at preventing capillarity than for structural reasons. At times, the walls of overlapping cob courses also rest directly on a shallow concave or convex ditch providing the same sort of vertical connection as straddling courses. The Lobi also embed the forked logs used for support into holes measuring approximately 70 cm deep with a stone at the bottom and filled with gravel to preserve the timber better.[105]

Finally, foundations raised on masonry or forked stilts are also worthy of mention; they are characteristically used in a large number of the country's grain stores and silos to protect the cereal and other food stored from the damp ground and pouring rain.

[105] Kéré 1995, op.cit.: 36

Adobe course used for foundations.

Pillars

Traditional pillars are made of forked logs which comfortably support the roof beams, either directly or with the help of other smaller logs used as wedges. The logs are dug into a hole in the ground over a bed of gravel which when well-built prevents damp from affecting the timber. There are also traditional adobe pillars used for the construction of sheds, but these are not nearly so common. In traditional architecture pillars appear in two situations: when the building enclosure is not structural or load-bearing but rather self-supporting, and when covering wider spaces, in an attempt to avoid the need to build an intermediate wall between the existing walls.

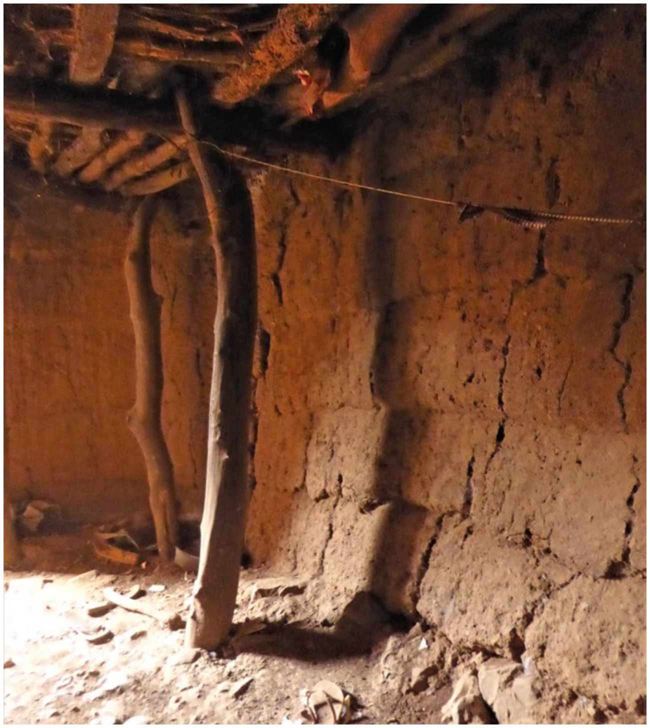
Lobi dwellings are a clear example of the former. The weakness of their mud walls of overlapping cob courses demands a sinuous outline with frequent breaks not only to gain inertia, but also in most cases to create a load-bearing structure of pillars for the roof alongside them. Inside the dwelling, the row of forked pillars runs parallel to the wall, while the beams are placed on the forks parallel to the enclosure walls. If the forked pillars are too short to reach the roof level they are built into the fixed earthen interior furniture (benches, platforms, etc.) to achieve a suitable height.

The diameter of these pillars in traditional dwellings is around 15-20 cm[106], although in the case of the *patam*, open markets and some sheds and external porches the diameter can be 6-8 cm. The logs from the shea tree, the African locust bean tree, African mahogany, and neem and other varieties are used as non-squared pillars.

Pillar with a forked end supporting the roof beam in a Bobo entrance.

But traditional architecture is in constant evolution due to external circumstances. The prohibition of cutting trees issued by president Aboubacar Sangoulé Lamizana (1966-1980) after the 1974 and 1976 droughts forced the Gurunsi ethnic group in the Sanguié province to adapt traditional architecture. The timber posts at each end were replaced with adobe pilasters reinforcing the enclosure perimeter, which could

[106] Kéré 1995, op.cit.: 16.



Pilar with a forked end beside a wall with overlapping courses in a Lobi dwelling, casting an intriguing staggered shade.

Ceiling in a Bobo dwelling, consisting of a beam, intercrossed joists and perpendicular logs and bark.

not withstand the weight of the beams on its own as it is only 7 or 8 cm thick. The central timber post occasionally used was also replaced with an adobe pillar.[107] In this regard, the progressive deforestation and desertization of the Sahel also point to a greater transformation of traditional architecture.

In addition, the Peul circular dwellings, built on a lightweight structure of intersecting and concentric parallel branches tied together, sometimes also need a central multi-forked pillar to guarantee or aid stability. Given the lightweight nature of the rest of the structure, the diameter of this pillar is usually under 10 cm. The forks are essential to support the ring of branches where all the branches converge at the top of the vaulted plant structure.

[107] Pecquet, Luc. To be published in 2025b. "Deforestation (Burkina Faso)". In Vellinga, Marcel. To be published in 2025. *Encyclopaedia of Vernacular Architecture of the World*. 2nd edition. London: Bloomsbury.

Floors

These are generally timber, although examples are increasingly found of vaulted structures, examined in a separate chapter. Floor structures are made up of beams and joists, as well as beam fillings of shingles, split logs and/or branches from the tree species mentioned above, depending on local availability. With the odd exception, these are generally laid out in the form of debarked rounded logs which have not been squared off. Irrespective of whether they rest on load-bearing walls or structural pillars they usually incorporate a double mesh: 15-20 cm beams, 7-10 cm intercrossed joists, generally close together with a tight beam filling on which the flat roof is usually built. These are very robust structures which at the outset can withstand the compacted earth of the flat roofs, at least 30 cm thick, a minimum dead load of 600 kg/m^2. The ceilings of the *patam* and porches feature a much lighter structure of beams and joists given that their beam filling and upper cover are made up of straw or plant mats.

As in most cases these are single-storey constructions, the floors adapt with ease to the sinuous outline of the timber of beams, joists and beam filling, while the upper infill levels off the upper plane of the floor or waterproofs the terraced roof. This levelling off is not necessary or significant in the case of the open air sheds mentioned previously.

Both supports with beams and beams and joists can be tied with Deccan hemp fibre (*Hibiscus cannabinus* L.) or similar materials.[108]

[108] Kéré 1995, op.cit.: 26.

This binding of the structural elements is essential for sheds exposed to the elements, as the lightweight structures, with no weight to hold them down, can easily be blown away by the wind coming through the open perimeter.

When larger logs are not available, some roofs are covered with thinner branches placed forming 45º angles and on these are placed parallel branches on two of the edges, covering shorter distances. Finally, branches are placed perpendicular to these. This system allows the use of branches to cover floors of half the span of a normal floor. Stone slabs or adobe, a waterproofing layer of clay and a final finishing stratum of compacted earth are placed on top.

Flat roofs

Flat roofs are found in some traditional constructions of Burkina Faso. They are generally made up of a 30-cm-thick layer of clayey earth with aggregate or sand (sometimes lateritic), pressed down on a stratum of leaves or a layer of bark. This in turn rests on a layer of branches and logs combined, supported by floor beams and joists. The outer edge of the perimeter of these flat roofs is 20-30 cm high. This edge acts as a safeguard against falls and prevents rainwater from pouring down the walls, instead channelling it along a slight slope towards an overflow, a hole or break in the edge, sometimes with a wooden spout or more recently, with plastic pipes which drain the water away from the perimeter of the dwelling. In other cases, the erosion caused by water running along the wall under the outlet is accepted, with regular maintenance being carried out due to the heavy exposure to water.

Section of the flat roof, as seen in the entrance of a Lobi dwelling, with a beam, crossed joists, thickly packed branches and 40-50 cm of tamped earth for waterproofing.

Advantage is taken of these gaps at the edge to access the roof and the ladders to the roof, a thick Y-shaped notched log ladder resting against the wall of the house below. In some Kassena dwellings a similar break in the edge is used for the access from built-in steps at the side of the building. The flat roof becomes yet another room of the dwelling and is normally used to spread out the clean laundry or to store objects, taking advantage of the sun.

After the rainy period this type of flat roof usually requires constant maintenance, consisting in compacting and smoothing the surface finish, occasionally preceded by the addition of a layer of earth in cases where thickness has been affected. Vegetation is found on flat roofs which have been abandoned or neglected, but this does not usually happen if the roof of a dwelling has been properly maintained.

The Birifor flat roof, where all sorts of activities are carried out, becomes the extension of the dwelling itself.

Flat roofs are common in the traditional dwellings of ethnic groups such as the Birifor, Bobo, Kassena, Lela, Lobi, Nuna and Puguli. The individual huts of the Kassena are covered with a flat roof with an edged perimeter, except in the case of huts in the shape of an 8, which also incorporate an internal edge in the smaller circle. The meandering Lobi dwellings have a single roof which follows the shape, with edges used to create panels subdividing the surface so that water can drain off.

Large square flat roofs, such as those of the Lobi, Birifor and Puguli dwellings, become raised arid earthen landscapes. Here only the perimeter edges, the intermediate low walls acting as separations to reroute the water in each section, the thatched hoods at the top of the silos and the mouths of the bottomless pitchers set into the roof to let light in, stand out. These dwellings sometimes incorporate built elements on the terrace surface which merge with single-storey huts constructed on natural terrain. The walls of overlapping cob courses, which are not load-bearing on the ground floor, sometimes become load-bearers for thinner ceiling joists in these volumes built on the flat roof. The effect on the flat roof is like a mirage as the roof surface blends into the ground and the line of the horizon. The compacted earth and ridges of the edges become a raised landscape on a different plane.

Compared with traditional circular huts in general, the rectangular rooms of the Mossi dwellings have spread relatively recently, in the 20th century, and are usually associated with adobe walls and corrugated metal roofs. However, some of these rectangular rooms occasionally include a flat roof of compacted earth.

In the case of the traditional Sudanese mosques built in adobe, large flat roofs with compacted earth are incorporated. The largest and most famous example is the mosque of Bobo-Dioulasso, although smaller ones can be found throughout the country. Other equally interesting examples, despite their more recent construction, are the complex of mosques in Bani. The large roofs are usually subdivided by ridges into smaller sections, equally compacted. Each of the sections is slightly sloping for water to run off towards the spouts on the walls. Like the flat roofs of the dwellings and that of the mosque of Bobo-Dioulasso, these roofs have bottomless ceramic pitchers which rise above the roof plane to prevent water from getting into the dwelling, and with decorated ceramic hoods covering them. These openings distributed over the entire roof plane illuminate and ventilate the interior space.

Roofs

The traditional characteristic sloping thatched roofs are disappearing at a staggering rate. The unique character of this type of roof in vernacular architecture throughout the country deserves to be conserved, despite the changes experienced in recent decades. The only reason for their current survival is the difficulty of roofing circular buildings with conical roofs such as huts or grain stores, where the use of a different material would be problematic.

The circular huts of the Gan ethnic group, which often even include a porch under the roof itself extended to the exterior, would be difficult to roof if it were not for the conical thatched hoods which can be adapted to the profile. The grain stores of the Lobi, Mossi, Dogon and even Kassena ethnic groups also require conical roofs which can be achieved with thatched hoods in different sizes. This is not exclusive to the grain stores: the typical individual huts of the Senufo and the cabins which are part of the fenced courtyard of the Mossi are traditionally circular huts with thatched roofs, while square constructions with flat roofs or corrugated sheet metal roofs have only recently sprung up.

In the Peul dwellings the shell of the lightweight structure lined with straw mats is also covered with a conical thatched hood. A particularly fascinating element is the lightweight construction, which seems almost provisional and harks back to the original nomadism practised by the Peul. It is built only with vegetal matter supported by thin branches acting as radial rods and the occasional central post. These roofs are sometimes supplemented with fabric at the top

Conical thatched roof of a Mossi hut, used to store and dry sheaves.

due to lack of maintenance. On other occasions the Peul make direct use of two braided straw mats to improvise a hut in record time. The first mat is placed vertically to form the perimeter cylinder of the hut while the second is placed on top in the shape of a vault. The Peul huts can be found standing alone in fields or around villages, sometimes with sheds, almost signalling how the inertia of their traditional nomadic life translates into a readiness to leave.

The upper openings of the mud silos, with conical mouths sometimes rising from the flat roofs of some dwellings in the southwest of the country, are covered with conical ornamented hoods made of densely packed and bound bunches of common reeds to form the wavy decoration, tied into a knot at the top with plant fibres. The exquisite execution of these small hoods shows the importance of protecting the inside of the silo from the rain.

The conical hoods have an umbrella-like structure of branches converging at the cusp and tied with intersecting pieces made up of thinner, more flexible, branches, reeds or common reeds, knotted at the points where they cross the rods. Their construction is usually a communal task in which the family, close friends and neighbours take part. The bundles of straw on the roof are attached to the hood rings made of branches and these, in turn, to the rafters. These bundles of straw on the roof are repaired regularly and occasionally reconstructed.

In recent decades, to avoid the maintenance of these traditional roofs for the dwellings there has been a proliferation of sloping roofs in sheet metal. This sheet metal solution is now so widespread that it has become part of the country's rural and urban landscape. These corrugated metal sheets do not rest on the natural logs traditionally cut on site as a rough guideline. Instead they rest on industrially cut timber which has to be acquired and transported from a distance,[109] with the financial cost increasing once the purchase of the metal sheeting and supporting structure is added.

In addition, the metal sheets are fixed well either with the adobe wall built up on the perimeter of the metal except at the water runoff, or with laterite masonry or prefabricated cement and earth blocks resting on the metal sheets to prevent them from blowing away in the wind. As already stated, only the conical configuration of the traditional circular huts and grain stores has stopped this material from also being used on this type of building. Nevertheless, it is also possible to find examples of conical roofs with corrugated sheet metal cut into different triangles and covering the joints with the same material, but these are not completely watertight, given the number of joints needed.

Rare thatched pitch roof made up of layers of sheaves overlapping on a rectangular Gan hut.

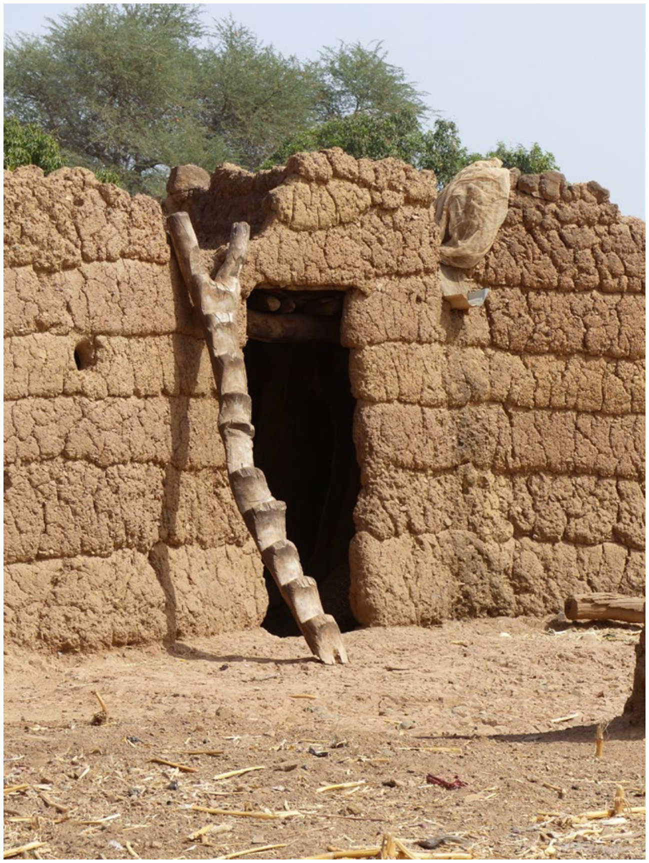
However, this saving in maintenance through the use of sheet metal has its drawbacks. In addition to the aesthetic impact of this modern material on the built cultural landscape of Burkina Faso, the interior temperature of these spaces becomes unbearable in the summer months, water steam and humidity from the ground do not pass through from the inside to

[109] Pecquet 2025b, op.cit.

the outside and the noise from the rain in the rainy season sometimes becomes intolerable. In fact, straw and other plants are often stored on the roof both to mitigate the direct incidence of the sun which overheats the metal and to prevent the drumming sound of the rains. Modern public buildings such as schools, churches and mosques resort in most cases to the use of sheet metal to waterproof the roof and attempt to mitigate thermal overload by enhancing cross-ventilation in the crowning of the roof.

Another disadvantage is the financial investment required for the purchase of corrugated sheet metal while traditional roofs are self-built using natural materials available to all inhabitants. Although sheet metal has a longer life cycle than a traditional roof, it is impossible to repair once it reaches the end of its useful life span due to rust or corrosion and has to be replaced with similar sheet metal, which means repeated financial investment. Unlike straw and timber the discarded material is not integrated into the landscape as earth covering or used as fuel. Since no recycling is possible sheet metal is abandoned, contaminating the landscape, or in a best-case scenario ending up in landfills.

In sheds, open stores and markets it is also possible to find flat thatched roofs resting on mats that are frequently repaired and replaced due to the effect of the rain or wind. A detailed description of this type of structure can be found in the section on sheds. Just as hay is placed on the shed structure, out of reach of the livestock but nearby so that they can be fed, bunches of millet or sorghum are sometimes placed on the conical thatched roofs of the huts.



Forked notched log ladder used for stairs in a Lobi dwelling.

Ladders, stairs, steps

The most common type of ladders, not just in Burkina Faso but also in different countries within the region, is a single thick log forked at the end in a Y-shape with steps notched out with an axe, leaning against the wall. These ladders usually run from the courtyard or the inside of the dwelling to the crowning in order to access the roof. The forked end makes the steps stable

Stairs built to access the flat roof of a Bobo dwelling.

Interesting masonry stairs in a Kassena dwelling with an intermediate staggered separation between the first flight of steps, also used as seats, and the second, specifically for accessing the flat roof.

enough for it not to fall sideways. Occasionally, a smooth log is placed at one or both sides, acting as a handrail to make it easier to climb up and down. These logs are often not straight, but slightly bent or curved so that the ladders follow the outline of the log all the way up. There are examples of wooden ladders made up of two poles with steps in between, although these are a recent addition.

In Kassena dwellings, as well as the ladders cut out of a log, houses and enclosures sometimes include exterior earthen steps up the side of rectangular or cylindrical constructions, occasionally with a banister also constructed in earth, thus increasing its organic nature. Similarly, major mosques such as that of Bobo-Dioulasso include built staircases to access the roof from the inside. These built staircases are usually made up of stringers of small logs or branches put together, on which steps are formed using balls of earth and similar timber thinner logs for the nosing, to shape the edges of the treads. Landings, when present, are built in the same way.

Vaults and domes

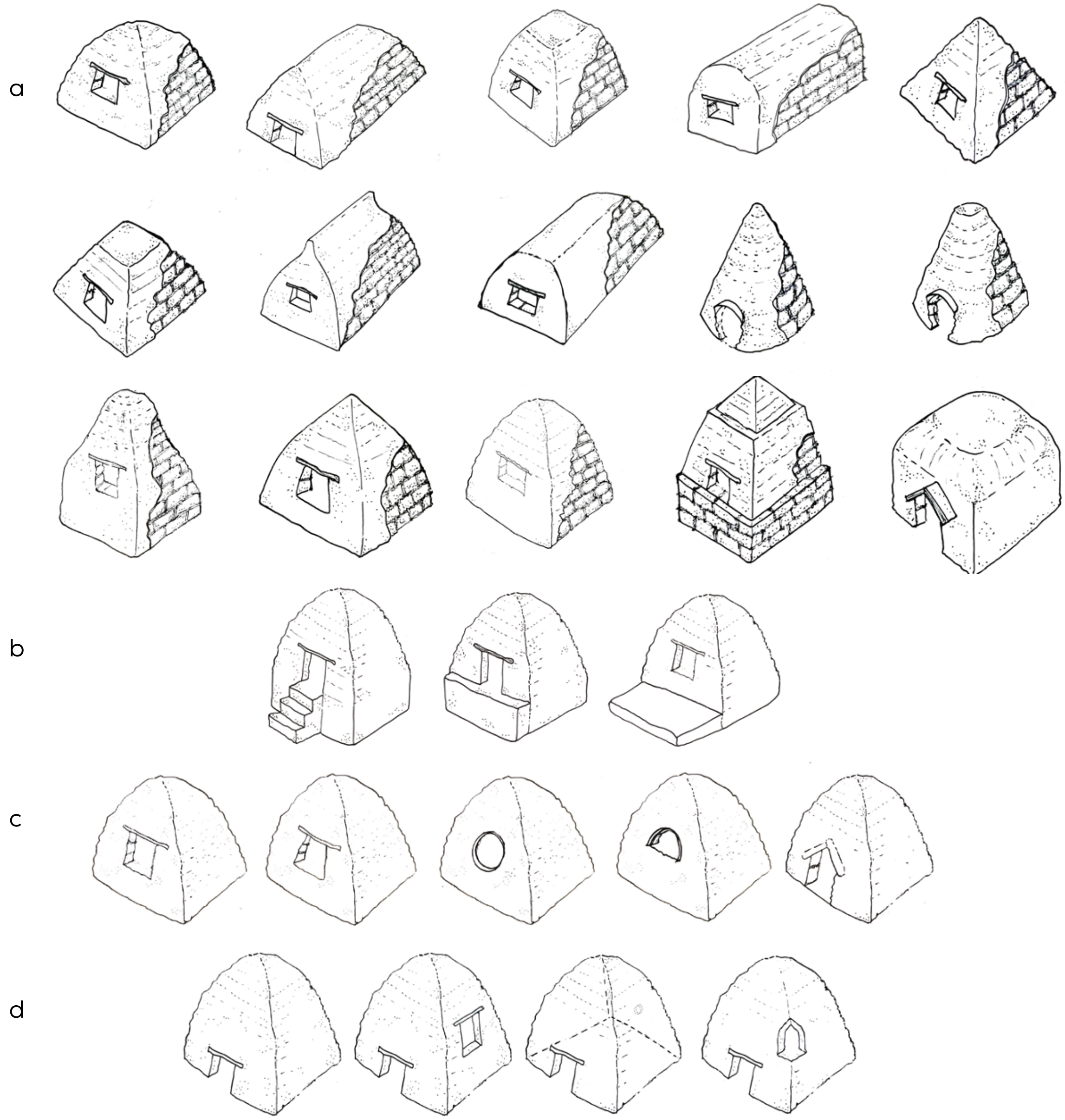
The traditional vaults and domes generally have two functions: the construction of ovens – normally for bread or ceramics – and occasionally to cover certain types of grain stores or silos. The use of corbelling vaults in mosques should also be pointed out, normally in the mihrab or in connection with the minaret, as well as the introduction of new techniques into the country including vaults built with leaning or curved courses, commonly known as Nubian vaults, and earthbag construction vaults.

Bread ovens. Ovens, which generally have a square or rectangular floor plan, are built in adobe bonded with earth mortar and usually measure no more than two metres on each side. After outlining the perimeter in the ground a minimum of four courses of adobe, or in some cases stone, are built to form the interior work plane, before building the corbelling vault with a succession of adobe courses. There are only a few examples of ovens built using masonry and laterite blocks.

These ovens generally have a single opening for wood fuel and the food to be cooked, although some have two independent openings at two adjacent sides at different heights which are used to control the fire and the food separately. There are also options which offer two openings, with the opening for food on one corner, or other openings to provide oxygen. Less frequent are the small ovens with a parabolic dome or pointed domical vault with a single opening. The openings can be rounded off with a triangular or round arch, or more often with a lintel. As a result, the openings can be triangular, circular, trapezoidal or rectangular. Although many do not have one, some ovens can incorporate an exterior work surface beside the opening in the form of an attached shelf or ledge level with the bottom of the opening or lower down.

Part of these ovens is rendered on the outside, improving thermal insulation of the heat generated inside and protection from the erosion of rain and wind. This rendering is renewed and maintained as erosion occurs, particularly on the upper, more exposed side. Some of these ovens are only rendered at the top to protect them from rain, or built under the shelter of corrugated sheet metal. Even so, a large proportion of them has no rendering of any kind.

The predominant form is the domical vault in which the four sections of adobe construction progressively meet to close the vault, transforming the four vertical corners of the base into four edges converging at the top of the vault. Sometimes these are veritable pyramidal domes built in the same way. It is also common to find truncated domical vaults, truncated pyramidal domes, bent pyramidal domes and trough vaults, truncated trough vaults or trough vaults with an ogee crowning to repel rain more efficiently. However, the malleability of earthen architecture makes it possible to quickly form pendentives on the square floor plan, generating forms which are practically parabolic, pointed,



Classification of bread oven vaults **a.** By type of vault. From left to right and from top to bottom: domical vault, trough vault, truncated domical vault, barrel vault, pyramidal vault, truncated pyramidal dome, trough vault with an ogee crowning, truncated trough vault, conical dome, truncated conical dome, bell-shaped dome, pointed domical vault, parabolic domical vault, bent pyramidal dome, truncated sail vault. **b.** By platform. **c.** By type of lintel. **d.** By position of the opening of the oven.

Bread oven with a pointed domical vault truncated at the top.

Bread oven with a coved vault where bread can occasionally be placed as the upper protective roof ensures water runoff is not a concern.

conical and even bell-shaped domes. This last type is a result of the search for stability in the successive approximation of the horizontal courses. Although less frequent, there are also sail vaults and the pointed or parabolic domes mentioned earlier. As some of these oven vaults are now covered by corrugated sheet metal, less pointed shapes can be used as it is no longer necessary to repel water, and the useful lifespan of the oven can be prolonged or, at least, maintenance postponed.

Ceramic kilns. Although in many parts of the country pottery is still fired on open fires, in some places such as the Lobi country there are specific ceramic kilns for firing pottery. These are kilns with pointed or parabolic domes about 2 m high, 2 m wide and 4 m long with two access openings and a chimney or flue at the back. Generally, the vaulted shapes and access openings adapt organically to form almost earthen sculptures of different sizes. The large central opening is used to introduce and extract the fired pottery pieces, while the smaller side opening is used to add wooden logs as fuel and to control the fire. These kilns are built with cob, shaped by hand, but thicker so that they can withstand the thermal expansion of the oven in operation, or even with solid buttresses on the outside. The chimney is independently attached to the wall at the end.

The kilns for firing ceramic tiles, for example, follow the same basic principles, but are larger and more complex in keeping with their function for production in the vernacular artisanal industry. They are occasionally built at the construction site in order to produce the ceramic tiles needed for the building, usually a public one, and are destroyed once the work is completed.

Lobi ceramic kiln with interesting curved vaults due to the presence of two access openings.

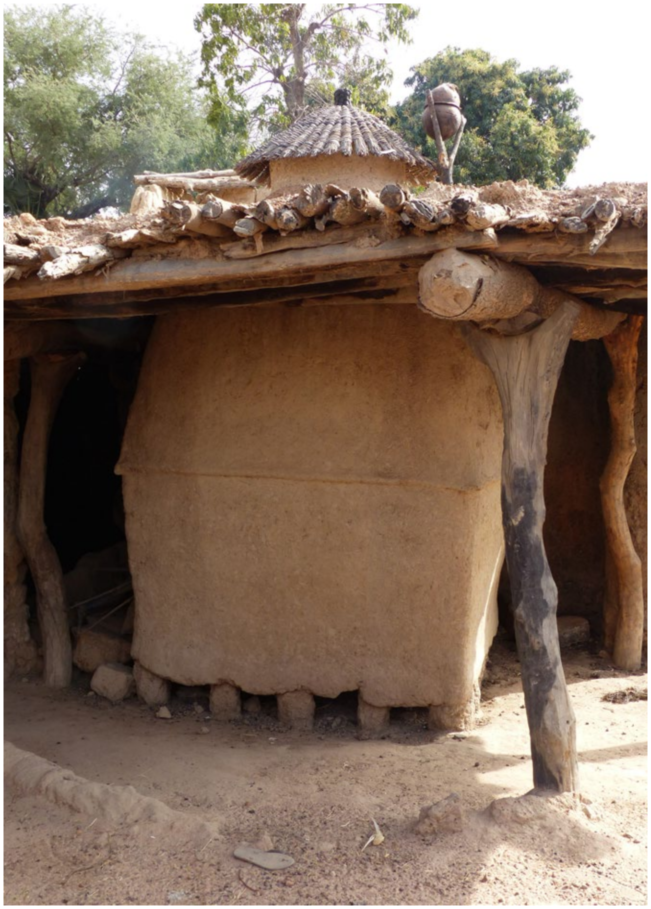
Modern ceramic kiln for firing tiles at a construction site.

Mossi furnace with a truncated pointed conical shape in Saye in the department of Bassi, reproduced in the Kaya Furnace Museum.

Domical vault in a Dogon grain store.

Finally, it is worth mentioning the different foundry ovens all over the country, which are occasionally covered with different types of vaults – pot, conical, bell-shaped, and roughly rounded – all of which are built shaping earth by hand. However, given their size and artisanal nature they would be better suited to the field of pottery than to that of construction.

Grain store vaults. Although most of the grain stores in Mossi culture adopt the shape of large baskets woven with vegetal matter, other types of grain stores are built with earth, some with completely closed cupolas. Unlike the oven vaults, which have to withstand a high thermal load and usually have to be built with adobe, these silo cupolas were built shaping earth by hand, gradually shaped with damp mud right to the top.



Bottle-shaped dome of a Birifor grain store protected under a roof.

The vertical divisions inside, generally in a cross or T-shape plan, permit a better classification of grain, spices or the objects stored in the different grain stores, while also reinforcing the structure. These silos, found for example among the Dogon peoples of western Burkina Faso, are covered with domical vaults if they have a square floor plan and with parabolic domes if the floor plan is circular. Grain stores with a square floor plan used branches as angle braces on the corners, bracing the walls and the ends protruding on the outside to tie the thatched hoods sometimes added for protection on top. Silos with a circular floor plan are more rigid due to the curved outline, despite the extremely thin shaped earth walls. Access for storage or extraction is through small windows on the vertical walls of the silos.

Other silos built inside the dwellings, as in the case of the Lobi, Puguli or Birifor, are covered with a vault intersecting the roof with a large oculus at the top covered with a small hood to prevent rainwater from getting in from the terrace. These silos, which generally have a cross division inside, are only accessed through the oculus. They follow a square floor plan and the first third of the walls is built vertically or widening slightly while the remaining two thirds are a pseudo-pyramidal vault with rounded corners. The final appearance is that of a fat silo embedded in the roof.

In the absence of logs or branches, mud vaults are also used to form the base framework supported on stones to raise it from the ground. This is the case of some silos of the Turka people in the west of the country which outline small vaults between the base masonry. There is also another type of silo built with termite nest earth or earth with a high laterite content, found in Mossi villages. They can also be built with the shaped earth technique, but thicker, and be vaulted around the upper opening, which is also thickened in turn.

Mosque domes. Mosque domes are also found in different forms although they are generally upright and tapered. They can be pointed, parabolic, conical, pavilion or very pointed

Pointed parabolic domical vault of the mosque of Bobo-Dioulasso.

Domes on the rectangular or cylindrical crenellated volumes of two mosques.

domical vaults. The pointed domical vault is the characteristic form of mosque tower in this African region, the most famous of which is the Bobo-Dioulasso mosque. The domes of this mosque feature logs which protrude from the surface as permanent scaffolding used for earth rendering during the annual maintenance following the rainy season. Another option for covering these towers is the constant stacking of volumes in decreasing size to reduce the span of the top cupola.

Although mosques are often lintelled, they can also incorporate arches on the façade and inside, although this architectural element is not common in the country. In this case they are small and can be triangular, pointed, parabolic or even lanceolate arches used on doors, windows or niches. Examples to mention include the Bani mosques, especially the Great Mosque, which combine arches, anthropomorphic niches, and small decorative perforations resembling embroidery and fretwork.

Nubian vaults. Nubian vaults, vaults built with leaning courses, do not require centring but rely on the adherence of the mortar and the friction angle between bricks. In the same tradition, there are also domes built with leaning courses, where the bricks, adobe bricks or CEBs are bonded in successive rings with a soft incline of 10º to 15º to prevent them from slipping until the dome is completed. The dome with leaning courses is traced with the help of a cord tied to a stake or with a mobile rod connected to a central tripod. This is used as a mobile radius for a spherical dome if taken from the centre, or for a pointed dome increasing the radius using a supplement linked to the centre. This technique is found in the constructive tradition of several Mediterranean countries and in the region of Nubia, between Egypt and Sudan. These vaults were made popular by the Egyptian architect Hassan Fathy (1900-1989) in the second half of the 20th century given their simplicity and low cost.[110] The association La Vôute Nubienne, which also works in the neighbouring countries of Mali, Benin, Senegal and Ghana has been introducing this type of vault into Burkina Faso in the present century. This association works towards the promotion and dissemination of sustainable construction with a low carbon footprint using local materials and artisans and generally resorting to the use of Nubian vaults to cover spaces. The association works not only on the physical construction of buildings, but also on teaching trades and, in particular, training builders in the Nubian vault technique. In recent years, as a result of the association's tireless work, the concept of the Nubian vault has become extensively known throughout Burkina Faso and examples of it can be found in various parts of the country.

Earthbag domes. Some recent examples of the construction of walls and domes with this technique can be found in Burkina Faso. The technique of earthbag construction invented by the architect Nader Khalili (1936-2008) consists in successively stacking long plastic or felt sacks full of earth and placing barbed wire between the courses to improve fixing while the walls are being built or until the dome is closed. This technique often results in organic architectures and rough rounded cupolas derived from the almost exclusive use of earth as a material for construction. These organic forms blend better into the local culture than other modern buildings as they achieve settings similar to those of the traditional circular huts, while the use of these courses of long sacks harks back to the rolls, coils or cylinders used in the country to make ceramics or build roll walls. However, there are still unresolved conflicts. Unlike the traditional earthen constructions the large amount of plastic or felt is not easily reabsorbed into the earth once the building has been abandoned. The need to add a hood to the earthen cupola in order to improve maintenance eventually also forces solutions using metal sheeting or tiles.

Vaults in contemporary architecture. The use of vaults and domes as sustainable architectural elements which cover spaces and allow water to run off, while avoiding the use of the increasingly expensive and unavailable timber, has been encouraged in the contemporary architecture of Burkina Faso from the 1970s onwards, from the

[110] Tono Martínez, José (coord.). 2021. *Hassan Fathy. A contracorriente*. Madrid: Ediciones Asimétricas.

Earthbag construction domes in Ouagadougou.

early examples of architecture built under the aegis of the Appropriate Technology Movement to the buildings of international cooperation architecture. The use of Nubian vaults described above also follows this philosophy. Specifically, the construction of CEB vaults and domes understood as a local product manufactured cheaply with low energy expenditure has become extremely popular in the last few decades. One of the most notable examples of the extensive use of arches, vaults and domes built with CEBs is Koudougou Market (2001-2005), designed by the Swiss Agency for Development and Cooperation and winner of the 2009 Aga Khan Award for Architecture. It is also worth mentioning the work of architects such as Diébédo Francis Kéré, Albert Faus and Chiara Rigotti, more information on which can be found in the chapter on cooperation architecture. The project we have developed for training in the construction of tile vaults is also moving in this direction, striving for further advances in saving on energy and raw materials.

Lintelled opening giving access to a Bobo dwelling.

Openings

Openings or perforations in the wall, vault or roof for access, lighting and/or ventilation of the interior spaces are few and far between in the traditional architecture of Burkina Faso. The main reasons for this are torrential rain, blazing sun and protection. The rooms in dwellings often only have an access door and the occasional small window, perforation on the façade or oculus in the roof. The same tends to occur with silos, which may only have a circular oculus on the crowning or a small circular, square or inverted semicircular window high up on one side.

Traditionally access to the oldest dwellings built using the shaped earth technique was through a roughly rounded arch, built at the same time as the enclosure, as is the case with the Kassena dwellings. It is also worth mentioning the interesting low earthen wall on the threshold, with several functions including defence. In principle, this low wall prevents the entry of animals and torrential rains. At the same time, once the threshold with a thickened earthen ridge or wood on the floor is crossed, a minuscule anteroom is accessed with a low wall which is sometimes U- or V-shaped. This is awkward to enter as it requires crouching to go through the arched doorway and then immediately having to step over the low wall. In combination with the contrast of light outside and the dim interior this provided better defence from invading enemies, who were left disoriented and helpless when they tried to enter.

Both the scarcity of timber and the soft earthen forms of shaped earth in fact suggest solutions for openings with arched and pseudo-parabolic forms, intrinsic to constructive technique and structural logic. In these cases it is also common for the exterior edge to be thickened, as if it were a fold in the wall, undoubtedly decorating or emphasizing the point of access, but also preventing the water running off the exterior enclosure from entering the dwelling. This edge can be complete or in the shape of an upper shield with sides which taper down until they disappear into the wall plane. At times the inner edge can also be thickened for decoration. In neither of these cases is there a door with a jamb on which to pivot. Instead, the access is left open to the elements or a rectangular, trapezoidal or bell-shaped mat is placed against it on the outside, woven in zigzag and on an inverted U-shaped framework built with the same vegetal materials. This framework can be removed from both outside and inside. Small logs are occasionally added outside to prevent the wind from knocking it over. A less common variant of this enclosure is to hang a straw mat attached with strips rolled on the lintel and rolled up and down as needed. The fact that there is no need for a door in the strictest sense reflects the type of community life and the protection provided by the dwelling enclosure, with its progressive filter between exterior public space and interior private space.

Over time, all the dwellings built shaping earth have incorporated taller quadrangular doorways with wooden branch lintels, large enough for a person to fit through. These have even incorporated wooden, metal sheeting, or improvised metal sheeting doors on a wooden frame, all with jambs for pivoting and closing. The doors open inwards closing against the inside face of the wall, in which case the exterior thickened edge is often preserved. They can

Tapered opening with a lintelled access to the Lobi dwelling.

Different types of opening of a Kassena dwelling: circular yard with a perforated wall of adobe brickwork; small window with slats; and lintelled access door with open perforations at both sides for lighting.

also open outwards closing against the exterior face of the wall, either respecting the perimeter thickened edge of the opening or eliminating it but then thickening the wall above the lintel to act as flashing or as a protection from dust.

For the same reason that traditional openings in shaped earth walls are built with upper arches, the openings of doors and small windows characteristic of walls made in adobe or similar blocks naturally adopt quadrangular shapes, with lintels made of sticks or wooden branches. The few examples of artificially dug-out architecture found in the country also feature openings with pointed, parabolic or pointed horseshoe profiles, equally reflecting a preference for the optimum structural form of the inverted catenary.

Small window for lighting a Kassena dwelling in the Royal Court of Tiébélé.

The narrow, tall quadrangular entrances to the circular adobe huts of the Gan ethnic group, the only source of light and ventilation for the dwelling, form the lintels taking advantage of the base structure of the conical roof hood. The doors are either non-existent, in rough wooden boards, or in metal sheeting. However, access to the exterior is not abrupt but frequently incorporates a porch which acts as transition as well as protection for the interior.

The woven straw huts of the Peul ethnic groups, with their domed shape with or without a hood, also feature a single access in the form of a rectangular opening, usually with no door or enclosure of any kind. Ventilation and lighting are diffused throughout the interior of these huts, as the fretwork woven walls are sufficiently perforated for light and air to pass through.

Lobi dwellings have quadrangular or truncated parabolic entrances, large enough for a person to be able to get through without crouching. These are built using three, four or even five overlapping cob courses on the wall either side of the doorway, and extending a wooden lintel over the opening to continue overlapping subsequent courses. Traditionally these are not enclosed, although in some cases they incorporate a shelf above to protect it from dust. Some dwellings also have large exterior openings the whole length of the roof between perpendicular walls, generally towards the courtyard or enclosure of the dwelling. Otherwise, these dwellings have few openings to the exterior, except for the occasional small window tucked into a space in a course, with the courses below and above acting as sill and lintel.

As with architectural, constructive, and ventilation solutions, the entrance openings to chicken coops and other auxiliary structures seem to imitate the access openings to dwellings but on a smaller scale. The chicken coops of the Gan ethnic group are particularly striking as they are like miniature dwellings, while the chicken coops of the Lobi ethnic group are sometimes built in pseudo-cylindrical shapes as high as the dwelling and attached to improve ventilation and climatization inside the coop.

The successive openings for ventilation and lighting incorporated into the wall are usually not enclosed in any way. There are generally three types of small quadrangular windows: not enclosed, with horizontal wooden slats or on a frame with metal slats. There are also some outward opening top-hung windows.

It is also worth noting the oculi made with protruding bottomless ceramic pots set in the roof to avoid water getting in, and sometimes combined with a dense conical hood of tightly bound thatch, a pumpkin bowl or a domed ceramic cover for use during heavy rain. These are occasionally decorated in monumental buildings such as mosques.

For doorways and windows contemporary architecture basically resorts to lintelled openings covered with wooden, metal or reinforced concrete lintels. Occasionally one finds openings with segmental arches in brick, laterite or CEBs, and pointed arches in religious or monumental buildings. Constructions with vaults and cupolas still frequently incorporate oculi for ventilation and lighting.

Solar filters

The high degree of solar exposure in Burkina Faso has traditionally led to a preference for darkness inside the rooms of dwellings, as well as the creation of ventilated filters to regulate the entry of light and to cool the interior. Building insects like termites seem to be well versed in this and to have taught it to humans. They build their nests under the shade of trees or consume the wood of these trees while respecting some of the outer bark to reduce temperatures from solar exposure in the trunks they continue to feed on.

The main filters are the tops of the trees themselves, with or without vegetation, or with straw stacked on their branches like hayricks which keep the hay throughout the year in order to gradually feed the livestock. The *patam* or sheds with timber pillars and framework on

Tree partially eaten by termites who have left the bark perforated to protect themselves from direct sunlight and reduce the temperature by a few degrees.

which straw is also stored in the form of a hayloft for conservation also provide shade for both livestock and inhabitants.

Architecture using braided straw mats, found widely in Peul dwellings and less frequently in Mossi dwellings, also provides a solar filter while guaranteeing diffused ventilation through the mats. The thatched roofs let out steam from inside the dwelling or grain store, although they are also designed to prevent rain and sunlight from penetrating.

Roll-up mats, both with reeds bound with strips and interwoven straw, are also used directly as filters or blinds hanging from porch

Reed mat filters to protect a porch.

beams in traditional and modern architecture. The concept of loosely woven fretwork filters is also applied to other elements of traditional architecture, in the form of interwoven fabric of basketry bowls, the pens of interwoven branches in open air chicken coops, the cylindrical wattles protecting young trees, or the cages with bars made of wood, reeds or common reeds used to transport poultry.

The modern architecture of Burkina Faso has come up with its own interpretation of all these characteristic filters in traditional architecture, especially in the form of ceramic or precast concrete perforated blocks in different designs. These are spread across the openings or even across the entire façade to provide complete and continuous ventilation for spaces. These perforated pieces also offer the opportunity to incorporate geometric motifs or local references.

Rendering in two types of earth on a Gan circular hut.

Rendering

Earth rendering, when present, is usually linked to adobe walls, as a form of protection, i.e. for mosques, although there are also many exposed adobe constructions. Furthermore, after the rainy season the mosques were traditionally subject to annual maintenance, smearing the adobe constructions with mud. This maintenance has even become famous, as in the case of the festival of the rendering of Djenné mosque in neighbouring Mali.[111] This earth rendering can be either very well-crafted, as in the case of the mosques, or a smooth rendering where the earth balls are revealed through erosion, or even simply a set of flattened earth balls which

[111] Maas, Pierre & Mommersteeg. 1992. *Djenne. Chef-d'Oeuvre architectural*. Eindhoven: Université de Technoogier

Earth rendering with fake ashlars.

may not be directly connected. Adding foreign elements such as cement or asphalt to the mix or even replacing traditional earth and straw rendering with cement mortar usually leads to major conservation issues. In fact, although initially eliminating the need for maintenance is advantageous, the remedy may finally be worse than the ailment.

In traditional earth rendering mud is spread up to 5 cm thick on the wall[112]. Occasionally, a second layer is added one to two days later, once the first layer is partially dry. The rendering is only done by hand or smoothed with a flat stone, generally after being left to dry for half a day.

Once the rendering is complete, a handful of fine straw is sometimes used to paint over with the juice of neré fruit (*Parkia biglobosa*), known as *boulbaka*. This substance, obtained by soaking the locust bean pods in water, acts as a sort of varnish and is used to fill the pores and small cracks of the rendering, protecting grains of sand from water erosion. Another option is to mix shea oil or any other type of plant oil directly into the rendering material, improving watertightness[113]. The rendering thus contributes to waterproofing the adobe wall and delaying the effect of rainwater which over time causes it to deteriorate, leading to the need for repairs. These repairs are carried out every one or two seasons, depending on the quality of the earth, the level of craftmanship and the orientation of the façade.

For most of the ethnic groups in the country, rendering is solely a response to a practical function. However, for some cultures such as the Kassena, rendering, finished off with traditional symbols painted on by the women using clay and ash in different colours, also becomes an aesthetic depiction. This helps to establish and conserve an entire collective imagery in the form of a symbolic language which harks back to the original identity of these peoples.

The techniques for directly shaping walls by hand, including shaped earth with rolls and overlapping cob courses, do not need subsequent rendering as the earth shaping process already provides a smooth protective earthen surface. In the event of erosion or degradation, shaped walls are not rendered with earth alone, but are repaired by shaping the deteriorated or missing parts.

[112] Kéré 1995, op.cit.: 34.

[113] Beaudoin 1998, op.cit.: 105.

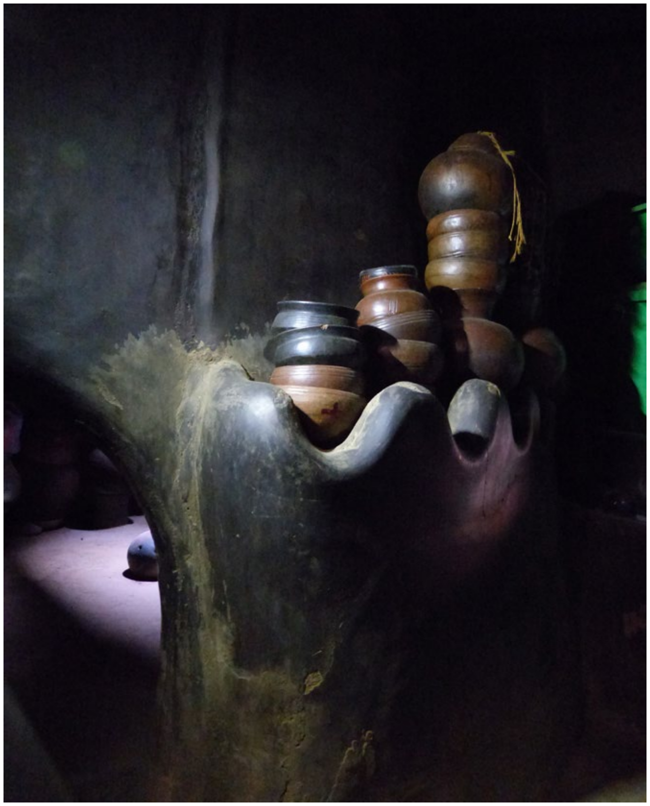
Interior of a Birifor dwelling.

The ancient walls in laterite masonry, such as those of Loropeni, incorporated earth rendering which is partly preserved today despite its age. The modern walls in cut blocks or laterite ashlar and those with CEB blocks are normally not rendered at all or, if rendered, use cement mortar, not earth. It is more common for walls with precast cement blocks to be rendered, although this is not an invariable rule.

Furniture

The furniture in dwellings throughout the country mostly tends to be fixed and built into the architecture. It basically consists of solid earthen benches along walls, both inside and outside the dwelling, and is found all over the country. One notable example is the Lela dwellings, with their uniquely shaped rooms made up of clusters of globes, with abundant perimeter earthen benches attached to the thin enclosures and

Interior of a Kassena dwelling.



Storage with stacked vessels in a Kassena kitchen.

dividing walls. These are often used as bases or plinths for the forked posts supporting the ceiling beams. These benches are generally built in three layouts: generally parallel to the walls when they are convex; in a secant line to the walls when they are concave, creating generous platforms; or polylobed, especially in concave walls with denser uprights, creating undulating individual ledges between them.[114]

[114] Pecquet 2025a, op.cit.

It is also common for earthen walls to include interior niches and cupboards, rendered or decorated in the same way as the interior of the dwelling, and used to store objects, vessels, etc.

Equally, the low walls that delimit the covered entrance porches of the huts of the Gan ethnic group, traced in an ear shape with an opening at the end for access, are also used as improvised ledges for sitting, facing both inside the porch and outside onto the rest of the village. Large stones, when they are available, serve the same

Interior of a Lobi dwelling with many of the household's stacked vessels.

Low wooden stool.

purpose, as improvised seats in markets or beside dwellings. In traditional schools, seats and stools for the children are made of cylinders of tamped earth; the only inconvenience is that they cannot be moved.

Beds are often solid platforms integrated into the interior architectural space, both with vertical walls or lightly tapering down at the base to create inverted skirting to allow clearance for feet closer to the platform. The beds of the Dogons are raised from the ground with the help of low masonry walls or simply loose stones on which intercrossed branches are spread under a mat for sleeping.

Kitchen surfaces also built as mass earth platforms rendered like the walls, occasionally including rims which keep foodstuffs separate, holes, built-in vessels, etc. Vessels and bowls

Dogon polychrome decoration in constructions perched below the high crags of the Cliff of Bandiagara.

made with empty pumpkins or other vegetable shells are occasionally hung on the walls around these kitchen surfaces.

The ceramic storage takes the strange form of a bench crowned with roughly rounded merlons, like egg holders, and used as a stop to protect the vertical piles of ceramic pots and pitchers, up to 8 or more per column in order of decreasing size. In Lobi dwellings these piles of pots rest directly on the ground or on a low built-in bench, accumulating up to 20 pieces. The number of pots and pitchers in each dwelling, which may be over 100, reflects the status of the dwelling's owner.

In addition to this fixed furniture other smaller pieces are added, including wooden stools with four legs and an oval seat; sloping Dogon seats made up of two decorated boards

Grey-headed kingfisher, a note of intense colour in the middle of the vegetation of the Nazinga reserve.

slatted together; Lobi seats incorporating anthropomorphic figures, probably linked to ancestor worship; or the freestanding Peul beds on raised timber platforms at single or double height and lined with mats.

This fixed and mobile furniture is combined inside the dwelling with the kitchenware and clothing: ceramic vessels, pumpkins hanging from braided cord, clothes hanging on the line, and large earthenware jars to store water or food. It is important to note that kitchenware and clothing are partially hidden from visitors and even occupants as they are kept in special silos. One example could be the "women's silos" within Dogon tribes, with vertical shelves housing the household goods, kitchenware and most valued clothing.

Decoration

The vernacular architecture of Burkina Faso does not always feature specific decoration. The existence, profusion and variety of the occasional decoration depend on the culture of individual ethnic groups. In fact, many of the ethnic groups of Burkina Faso reserve colour and decoration for fabrics and clothing. The Dogons are an ethnic group with a characteristically monochromatic decoration, in the colour of the material, which can be earth or timber. In this case, decoration sometimes takes the form of mud haut-reliefs on the dwelling walls which are generally anthropomorphic or zoomorphic. The exquisite wood carvings of their doors and windows are veritable sculptures that are reminders of the individual cosmogony of the Dogon peoples, telling stories or bringing good omens to the dwelling. This ethnic group is also

A Dogon woodcarver working on doors and windows reflecting the Dogon cosmogony.

The sinuous striated walls of a Lobi dwelling respond to constructive and structural needs while also displaying unique beauty.

characterized by its polychrome paintings, but these are not so much found in the Dogon villages of Burkina Faso as in the villages of the Cliff of Bandiagara, in neighbouring Mali.

There is also what could be described as an involuntary decoration or aesthetic stimulus in the case of the vernacular architecture of the Lobi, in Sansana, where there is no express desire for ornament or figurative representation. However, the walls constructed in undulating overlapping cob courses display a sculptural beauty which accompanies the intrinsic vernacular essence of the buildings, also worthy of mention. In Sansana or Obiré, the capital of the Gan, the decoration is also outstanding, although its main function is linked to sacred rituals, fetishes made of wood

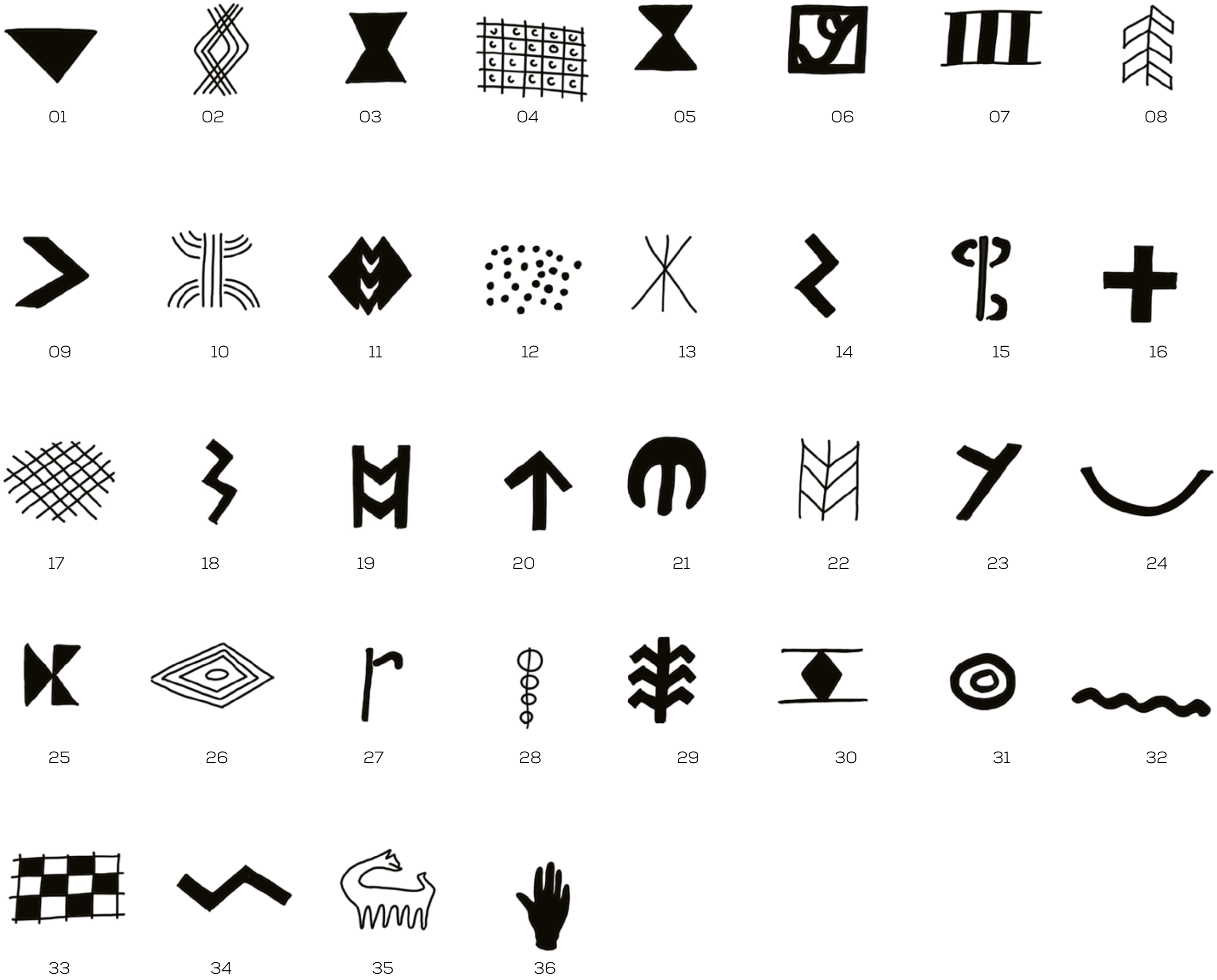
Decorated walls of a Kassena dwelling seemingly blending in with the shade from a sheltering tree.

and mud firstly representing ancestors, and secondly the royal dynasty. These are used in spells to plead for family prosperity.

In architecture, however, the exceptional role of pictorial decoration in the Kassena dwellings, produced by the local women of each village, reflects local symbolism and mythology as good omens for the inhabitants. This tradition dates back to at least the 16th century.[115] Huts are painted in strong colours such as white, black, red, earth brown, etc. with geometric patterns featuring triangles, diamonds, ribbons, strips, dots, etc. combined with bulges or incisions

[115] Wilquin et al. 2021.

Process of reconstruction of the polychrome rendering of a Kassena dwelling in Tangasogo.



Meaning of Kassena symbols according to Jacques Pibot. Captions: 1. Pumpkin. 2: Net of pumpkins. 3: Mortar. 4: Strategy game. 5: Speaking drum. 6. Doe's knee. 7: Shroud I. 8: African Carob tree leaf. 9: Hoe. 10: Guitar. 11: Ceiba tree fruit. 12: Panther skin. 13: Broom. 14: Chicken's foot. 15: Fan. 16: Latin cross. 17: Net. 18: Hawk. 19: Bent knee. 20. Arrow. 21. Umbrella. 22. Handshake. 23. Sling. 24. Bow. 25. Vampire 26. Scarred mouth. 27: Reed. 28: Rattle. 29: Ear of millet. 30: Shroud II. 31: Moon. 32: Snake. 33: Fantasy. 34. Bat. 35: Giraffe. 36: Hand.

Process of painting the decoration of a Kassena dwelling in Tangasogo.

Process of painting the decoration of a Kassena dwelling in Tangasogo.

Mossi woman decorating pottery before firing. This is the same system – but on a larger scale – as the ancestral decoration of some traditional earthen huts highlighting the geometric pattern, adding textures or serving as a template for the necessary periodic renovation of the painting. Kassena decoration, especially black and white patterns, seems to be inspired by and blend in with the lights and shadows created by the surrounding trees and sunlight. After a decline in popularity of this maintenance routine for decoration, some initiatives have arisen for the revitalization of this activity, given its potential to attract cultural tourism to the area.[116] This decoration transforms architecture into a veritable communication tool, an open book that may be read with the knowledge of the origins of their ancestral culture.[117]

In the decoration of a hut, the female owner takes on the role of master builder while the rest of the women become active artists. The materials used are traditionally natural: powdered earth, powdered laterite, cow dung, greyish sand, ashes, African locust bean tree (*Parkia biglobosa*), okra (*Abelmoschus esculentus*) for the colour black and light limestone for white. Their tools are flat pebbles, handfuls of guinea fowl feathers for paintbrushes, small brushes made of natural fibres, pots, plant pots, etc. In recent years attempts have been made to introduce non-traditional materials, such as asphalt for the colour black or synthetic artificial pigments, although the results have been unsatisfactory given their rapid degradation. Furthermore, climate change is causing heavier and more intense rain, also threatening the survival of these paintings.[118] The process is as follows: an initial rendering in cow dung mixed with water and greyish sand is applied by hand to a previously dampened wall and then smoothed; a second rendering layer of cow dung with water and powdered laterite is applied with pressure using a flat pebble dampened in water, as a screed or spatula, which are also used to trace furrows; coloured paint is applied; once the paint is dry, a layer of boiled and ground African locust bean juice is added to guarantee watertightness.[119]

[116] Barillet, Christian; Thierry, Joffroy; Longuet, Isabelle (eds). 2006. *Cultural heritage & local development. A guide for African local Governments.* Grenoble: CRATerre-ENSAG / Convention Francesc-UNESCO: 92.

[117] Pibot, Jacques. 2001. *Les peintures murales des femmes Kasséna du Burkina Faso*. Paris: L'Harmattan.

[118] Wilquin et al. 2021.

[119] CRAterre-ENSAG 2014, op.cit.

The importance of intangible knowledge on the decoration techniques passed down through generations of women.

9. Heritage

Burkina Faso has a truly vast and varied cultural, intangible, architectural and landscape heritage, in keeping with the country's geographical, geological, climatic, cultural and ethnic diversity. It should be stressed that traces and remains of settlements dating from 1200 BC have been found among the archaeological sites, progressively increasing from the first millennium BC. In archaeology, the most unique remains are the sites with paintings and rural engravings in Pobé-Mengao, Arbinda and Markoye, in the tentative list of the UNESCO, and the walls of Loropeni, near Gaoua, in the province of Poni, declared a UNESCO World Heritage Site. These walls are undoubtedly the best conserved example of a fortified settlement in West Africa, linked to the tradition of gold extraction. Also of great interest is the necropolis of Bourzanga, with two types of burial site groups: one with Dogon funerary vases and another royal necropolis with Kurumba stelae. Other local buildings such as the Palace of Kokologho are more modest but are still much cherished and highly symbolic heritage for their occupants and for residents in the region.[120]

The diversity of landscapes in the country, often in symbiosis with vernacular architecture born directly from local materials, is also worthy of mention. In addition, as many of these elements of the landscape are sacred in their local cultures, they are already protected by the inhabitants. These include forests, rivers and lakes and the trees or animals inhabiting them, such as the ponds with hippopotamuses or crocodiles, places which transmit their sacred

[120] CRAterre-ENSAG, Direction du patrimoine culturel du Burkina-Faso Pays (eds). 2005. *Le Na-Yiri de Kokologho*. Grenoble: CRAterre-ENSAG; Napon, Abdoulaye & Rakotomnamonjy, Bakonirina. 2005. "The Na-Yiri of Kokologho". In Joffroy, Thierry (ed.). 2005. *Traditional conservation practices in Africa*. Roma: ICCROM: 6-13; Kaboré, Barthélemy. 2005. "Le Burkina s'engage advantage dans la protection du Patrimoine culturel immobilier". *Africa 2009. Chronique* n. 5: 15.

The walls of Loropeni, inscribed as UNESCO World Heritage.

aura to the animals living in them. Among these landscapes it is worth noting the W-Arly-Pendjari complex, between Benin and Burkina Faso, an expanse of Sudan-Sahel savanna with a wide variety of vegetation including grasslands, bushes, trees, riverside woodland, and the largest continuous series of land, semiaquatic and aquatic ecosystems of the African savanna. The tentative UNESCO list also features the biosphere reservation of the Bala hippopotamus pond, with a vast wealth of fauna and vegetation, including more than 160 bird species and other animals and a great variety of trees. Other beautiful landscapes include the Sindou Peaks, Karfiguela Falls, the Domes de Fabedougou and Lake Tangrela.

In addition, this vernacular architecture in symbiosis with nature is one of the richest heritage assets of the country. This heritage is extremely widespread and has been conserved with few transformations throughout the country. It would be wonderful to be able to preserve this for the future, as it confers individual enclaves with an extraordinary character and identity. There are almost as many types and variants of vernacular architecture as ethnic groups in Burkina Faso, although constructions initially use the same materials: earth, timber, straw and occasionally shea butter. Among the numerous important examples of vernacular architecture we find the grain stores of Niansogoni, the straw huts of nomadic Peul architecture, the groups of silos of the Mossi, the fascinating Lobi *sukala*

Les Domes de Fabedougou, a site of hypnotic beauty.

The two towers of the Bobo-Dioulasso mosque, photographed from the upper terrace.

or the Kassena villages, especially the royal court of Tiébélé, a village with magically fascinating polychrome decoration by local women which is also included on the UNESCO tentative list. Some vernacular architecture settlements are now considered historical heritage, including the city of Bobo-Dioulasso, the original historic nucleus of Sya, also on the UNESCO tentative list.

Equally, there are notable examples of ancient metal production in Burkina Faso which are also declared UNESCO World Heritage Sites. These include mines, outlines of dwellings and metal foundries found in several enclaves in different provinces of the country, including Douroula, the oldest iron production remains found in Burkina Faso, dating from the 8th century BC. These paleometallurgical kilns are ancient proof of human technology that is rarely seen in other continents, where they have been destroyed by development. They are a milestone in human history, marking the passage from stone civilization to metal civilization. In addition, this type of primitive technology was alive until recently. It is therefore a mixed material and intangible heritage. The Kaya Furnace Museum houses a collection of this type of iron ore extraction technology not just from different places in Burkina Faso, but also from other West African countries such as Ivory Coast, Mali and Niger, showing the extraordinary treasures found in these countries, which have managed to preserve these cultures, these kilns and the iron mining trades from prehistoric times down to the present.

Among the most contemporary examples we find the site of Laongo, a granitic outcrop used since 1988 as a gathering place for artists and sculptors from around the world to create an open air sculpture park which is now huge and internationally famous. Or the seven mosques of Bani, built in recent decades using traditional earthen materials and techniques, already part of the country's heritage and which attract national and international tourism. Or even the Central Market in Koudougou (1999-2005), a large fully functioning building designed by Laurent Séchaud and Pierre Jequier, constructed exclusively using sail vaults with Compressed Earth Blocks (CEBs), winner of the Aga Khan Award for Architecture in 2007 and a finalist for the Terra Award in 2016. This market has already become part of the contemporary heritage of Burkina Faso.

The vast project Africa 2009, carried out by ICCROM, the Centre for World Heritage of UNESCO, CRAterre-ENSAG, EPA and CHDA, boosted the promotion of a system for the protection of cultural built heritage in Burkina Faso, among other things. This initiative began with a themed inventory of this heritage in collaboration with the Burkinabe government's Directorate for Tourism, simultaneously aiming to promote cultural tourism, a major source of income for Burkina Faso. After the inventory, the protection process which had been paused was restarted, and 114 assets of cultural interest were recorded. Of these, 44 were awarded a higher degree of protection given their great importance. Furthermore, a campaign to raise awareness about the importance of these assets was also launched, aimed at the local population. This inventory also recorded the state of conservation of these assets, which was deeply worrying in some instances. Since then, in heritage sites that are not private in the strictest sense, like the Royal Court of Tiébélé, minor conflicts have arisen on the maintenance, use and allocation of the profits from cultural tourism, which the Service for Traditional Sites, Monuments and Architecture of Burkina Faso is attempting to resolve.[121]

[121] Kaboré 2005, op.cit.

Image of the Kassena people of Tangasoko.

The extraordinary painted dwellings of the Kassena, included on a tentative list for UNESCO World Heritage.

Historic furnace in Tiwêga, in the province of Sanmatenga, near Kaya, declared UNESCO World Heritage.

Paleometallurgical furnace of Bouo Nombiel, in the department of Legmoin, reproduced in the Kaya Furnace Museum.

At the Kaya furnace museum.

Paleometallurgical furnace of Boulsa, in the department of Namentenga, reproduced in the Kaya Furnace Museum.

Adobe wall, eroded due to exposure to the elements.

10. Common deterioration in architecture

The pathologies most frequently affecting the constructive materials and traditional buildings can be divided into three major categories: firstly the damage resulting from issues in the design, material or execution; secondly, deterioration caused by lack of maintenance; and thirdly, degradation triggered by the introduction of incompatible materials or counterproductive constructive solutions, that usually seek to prolong the life of the traditional building by postponing its maintenance, although in the long run the solutions become more problematic than the initial issue.

Issues in the design, material or execution

There are some deeply rooted local customs which, though not considered defects as such, do contribute to possible deterioration. These include the absence of foundations or plinths for earthen walls. This initial weakness is counterbalanced by the traditional widening of the first courses of the base in the case of walls built with shaped earth rolls or with overlapping cob courses, so that there is leeway in the thicker section to combat possible erosion at the base. This is not the case of adobe constructions which have the same section throughout the entire height, so that it would be preferable for the foundations to drain off or a plinth to be added. Another issue is the lack of suitable protection on the crowning, not so much that of the thatched hoods which usually have long eaves, but rather the exposed walls, which are another weak point potentially causing progressive degradation.

The mix of earth and occasionally straw which is used for the construction of overlapping cob course walls or for the earth rendering cracks easily due to retraction when drying out, both because of the insufficient degreasing agents such as straw or aggregate and its high water content. Although this in itself is not a defect, it can increase water penetration and exposure. These cracks are not commonly found with other

Hole in a hut with earthen walls in a Gan village, caused by collapse and probably due to excessive damp.

techniques such as adobe construction, where these pieces are shaped steadily with mud in small moulds or in rolls, until they are compacted.

In adobe walls it is more frequent to find the courses curved or sloping, when they are bonded on uneven ground with no builders' lines for levelling off. From the outset this is not a constructive error but simply an aesthetic issue. Walls built with shaped earth rolls tend to suffer more recurrently due to their thinness and fragility in the case of the absence of dividing walls or internal bracing, the physical impact of animals and humans, and exposure to water. All these factors can lead to holes or partial collapses.

In structural terms some initial weaknesses can be identified: the danger posed to timber beams and roofs by the abundance of termites; the instances of rot due to sporadic contact with damp affecting the timber pillars set in the ground, with no foundation ditch to provide drainage through the gravel; the uneven or incorrectly counterbalanced thrusts in rectangular constructions that could cause lesions in the walls. Damage caused by erosion to the base of the earthen walls – described above – can even cause structural problems if left untreated.

Lack of maintenance

While lack of maintenance is a pressing problem for all types of buildings, it particularly affects constructions built with soluble materials like earth or perishable materials such as thatch, both important constructive materials in the traditional architecture of Burkina Faso. Earthen

Dogon silo in semi-ruins due to lack of attention and repair, with its constructive section perfectly visible.

architecture is extremely efficient and durable, providing its base is protected from capillarity, runoff water and splashing and the crowning is protected from the rain. Major issues can result from a lack of maintenance of the solid ground, causing water to build up at the foot of the walls, or from thatched eaves which do not cover the crowning of the wall.

Equally, the lack of maintenance on a flat tamped earth roof and on drainage spouts can cause dwelling infiltrations, rotting the timber beams and floor joists or attracting termites; the disappearance of the low edge walls due to exposure to rain subsequently washing away the vertical walls; and changes in the roof slope,

Mossi silo with plant walls which have lost their form as their creeper hoops have loosened and the perimeter palisade has moved.

problems with draining water, water build-up, etc. Maintenance for more perishable materials such as the thatched hoods of huts, silos or grain stores, the braided straw mats and, often, earthen rendering periodically leads to the complete replacement of the materials.

The degradation of adobe walls takes the form of erosion of the adobe pieces and the joint mortar where they have been exposed to damp. The washing away and erosion of walls with overlapping profiled cob courses reveals the clay balls which originally formed the course. The deterioration of a wall built with shaped earth rolls usually leads to fragments dropping off, leaving gaping holes. The degradation of a roof hood begins with fabric rotting or fraying. The degradation of a grain store built in the form of a large interwoven basket can result from ageing of the mat of the thatched hood and loosening of the cord or hoop strips, or the alteration of the rods or support poles. Mud rendering occasionally applied to adobe walls usually reacts to the elements and eventually becomes detached. Exposed adobe walls are gradually washed away and erosion from exposure to wind and rain can be seen on the walls.

Introduction of incompatible materials or constructive solutions

Modern materials in themselves are not harmful, but it may be impossible or complicated to combine them with some traditional materials, causing their degradation and possibly even ruining the construction. Most of the examples shown below share the following process: 1-incorporation of a novel material that is alien to the traditional context and avoids maintenance; 2-initial elation at having seemingly avoided the need for maintenance; 3-the need to restore or reconstruct the architectural element due to the medium-term degradation. The type of deterioration caused in these cases is more sudden, violent and unnatural than that observed in a traditional material.

Crack on a corner caused by a poor connection between the two converging walls.

Cement mortar, which is now extremely widespread, is not the ideal material for rendering or bonding an earthen wall. Although it apparently avoids the need for maintenance it can cause the degradation and collapse of the wall in the short and medium term. There are several reasons for this: earth has a higher capacity for vapour breathability than cement mortar, so that the steam and humidity from inside the dwelling or capillarity accumulate inside the earthen wall with no way out. In addition, when damp occurs cement mortar also attracts minerals which can migrate through the wall, weakening it causing the adobe to fall

Aerial termite nest beside a tree and close to a house, a potential cause for issues in timber structures.

Gullies in the ground due to water runoff in the rainy season; in this case they threaten to bring down two trees whose roots have been left partially exposed.

apart or sometimes generate efflorescence on the wall or inflorescence inside it. This is also observed in walls waterproofed with bituminous materials which protect the wall from rainwater outside but can cause severe damage as they are less able to let steam out through the walls. Finally, the use of corrugated sheet metal or plastic sheets to waterproof the roof also initially avoids the need for maintenance for the traditional thatched roof, but causes unbearable heat inside, and hinders the natural breathability of thatched hoods, potentially causing damp to accumulate in the walls.[122]

In the context of this tradition, it seems that the development of different ethnic groups in rural settings must entail innovations and changes which are starting to be observed in different forms of construction. Perhaps due to the increasing scarcity of timber, one of the most visible transformations in traditional architecture is the preference for new materials such as the metal pieces used to construct roofs, doors and windows. Changes are also being observed in the different ways groups are formed and in the building typologies, possibly as a result of changes in how dwellings are inhabited.

[122] Hunt, R. & Suhr, M. *Old House Handbook. A practical guide to care and repair*. London: Frances Lincoln Limited, 1988: 36, 60, 102.

Poor maintenance of a thatched roof, leaving the adobe construction exposed to rain and therefore at risk of collapse.

The damp in the ground, worsened perhaps by the presence of cement in the joint mortar, is causing erosion in the adobe bricks most in contact with the ground.

In the 1970s Babar Mumtaz commented on these changes as follows: *It remains to be seen whether architecture will reach the same level of social and geographical harmony as the current indigenous forms.*[123] This, however, does not seem to refer only to "harmony" but also to be linked to the "identity" of these peoples. In fact, in the statement above both terms are interchangeable. The question is therefore whether it is possible to strike a balance between the conservation of vernacular architectural heritage and the need for development or whether in contrast the current progress of society will inevitably lead to a culture assimilated into the rest of contemporary constructive cultures.

From the start, famous architects such as Kéré have used materials in their walls which are a compromise between local resources and contemporary technology, for example CEBs, also aiming to instil credibility concerning these constructions among local residents. Kéré has used more recent projects to experiment with the rammed earth technique, occasionally improving it with cement additions. He has also used CEBs in roofs, while the secondary upper roof characteristic of his work is a metal structure with iron rods soldered as a truss and corrugated sheet metal, a contemporary solution which is both practical and inevitable for covering large non-domestic spaces.

[123] Mumtaz 1978, op.cit.: 100.

Detachment of the carved and painted rendering of a house of the Royal Court of Tiébélé, probably due to the damp caused by rain.

Zoomorphic figures affected by impacts in a Kassena village.

Joints and cement mortar rendering on the adobe wall which is gradually wearing down the body of the earthen wall, due to incompatibility between the two.

A case similar to the previous one, causing more damage to the lower sections of the wall.

Two children in the artisan neighbourhood of Bobo-Diulasso.

Waste, generally from plastic, which particularly spreads to the perimeter of the settlements, hinders agriculture and blights the natural landscape.

Pollutant waste generated by humans and left in natural settings

This problem is not specific to Burkina Faso but is a global issue which is all the more pressing in developing countries. Waste such as synthetic fabrics, cigarette butts, cans, glass, rusted metal, tyres and especially plastics takes decades or even centuries to degrade completely in the environment, piling up around human settlements, lakes and rivers. The result is a problem which is not only aesthetic but also affects the quality of life and health of animal species, who inadvertently consume this waste material as part of their diet and so pass it on to humans. The dramatic case of the river Houët in Bobo-Dioulasso in the international hydrographic basin of the Volta, full of catfish who also feed off floating waste, is just another blatant example of this real threat.[124]

[124] Ouattara, Yacouba; Guiguemde, Issaka; Diendere, Françoise; Tall, Nassouru; N'Diaye, Soumaïla; Diarra, Jean; Sanou, Ardjouma; Bary, Abdouraman. 2012. "Le marigot houët a Bobo-Diulasso: une question de santé publique?" *International Journal of Biological and Chemical Sciences* no. 6(5): 2003-2015, Oct. 2012.

As it passes through Bobo-Dioulasso, the bed of the river Houët looks like a rubbish tip.

Maintenance proceeds for a dwelling, with the repeated rendering of walls with mud.

11. Maintenance

Maintenance is necessary in all types of architecture, both traditional and contemporary. Vernacular architecture, especially earthen architecture, is no exception. For example, earthen rendering and thatched roofs have a limited lifespan when faced with the action of wind or rain and can therefore be considered ephemeral elements.

Other elements such as adobe walls or shaped earth walls display conditioned longevity. This means that they are intrinsically vulnerable and require external protection or maintenance. They may need plinths for protection from rain or rising damp or a crowning protected from rain. The longevity of timber is also conditioned by adequate ventilation and protection from damp. Finally, elements such as stone walls have a guaranteed lifespan which normally exceeds that of a human being.

The types of longevity of materials are interconnected in constructive techniques. The longevity of a grain store built with thin shaped earth walls covered with a thatched hood is subject to the good condition of the thatched roof, but the ephemeral nature of straw can jeopardize the entire grain store if it is not maintained.[125]

In most cases, maintenance of materials with ephemeral longevity involves replacement, not only because of the constant pragmatism of vernacular architecture, but even from a conservation stance in the field of restoration. However, given the new intensity of rain due to climate change, traditional maintenance may not suffice and further attention may be required. As an example of this, on 8 August

[125] Mileto, Camilla & Vegas, Fernando. 2009. "Strategies and actions for the conservation of corbelled dome villages as urban and architectural landscape". In Mecca, Saverio & Dipasquale, Letizia. 2009. *Earthen Domes & Habitats*. Pisa: Edizione ETS: 469-476.

Bundles of straw prepared to repair existing roofs in a Gan village.

Example of the system for tamping the earth of the flat roofs of Kassena dwellings repairing them with a rammer.

Periodic reconstruction of an earth rendering.

2021, a side of the minaret of Bobo-Dioulasso mosque, built in adobe, became detached shortly after restoration work had been carried out.[126] A few days later the minaret collapsed completely.[127]

In the decorated Kassena villages, maintenance of the exterior ornaments of the dwellings is based on the reconstruction of

[126] Admin. 2021a. "Burkina Faso: Réhabilité il moins de deux à plus d'un demi milliard de F CFA, une partie de mosquée de Dioulassoba s'est effrondé". NetAfrique. 08-08-2021, https://netafrique.net/burkina-faso-rehabilite-il-moins-de-deux-a-plus-dun-demi-milliard-de-f-cfa-une-partie-de-mosquee-de-dioulassoba-sest-effronde/, acc. 01/12/2021.

[127] Admin. 2021b. "Mauvaise nouvelle à Bobo-Diulasso: Le minaret de la grande mosquée de Dioulassoba s'écroule totalement". NetAfrique 13-08-2021, https://netafrique.net/mauvaise-nouvelle-a-bobo-dioulasso-le-minaret-de-la-grande-mosquee-de-dioulassoba-secroule-totalement/, acc. 01/12/2021.

Tower of the Bobo-Dioulasso mosque bristling with sticks and branches used to periodically climb and repair the mud rendering.

Detail of the sticks and branches for climbing the tower of Bobo-Dioulasso mosque.

rendering, motifs and polychromy in three-year cycles.[128] It remains to be seen whether the greater intensity of rainfall will require more frequent interventions in order to guarantee their survival, not to mention the economic difficulties and loss of trades faced by the Kassena.

The longevity of the timber structure of traditional buildings in Burkina Faso is also conditioned by several external factors. The first is the watertightness of the flat tamped earth roof to prevent any filtrations from affecting it. The second is the ventilation of spaces and the beam heads in the walls, which help to keep the timber dry. One example is the smoke from the hearths of the indoor kitchens which cover the timber in soot and is a traditional treatment against termites, offering protection from new swarms.

[128] Wilquin et al. 2021.

Kassena woman sprinkling water on the flat roof prior to repair.

Kassena women chiselling off the old rendering before applying the new one.

Process for dampening the earth walls prior to rendering.

PART 3. BAASNEERE

The following chapters offer a detailed account of the study in the village of Baasneere, where the NGO Algemesí Solidari has concentrated most of its efforts. Educational workshops were set up for the construction of tile vaults, together with awareness activities on earthen construction with children from the local primary school and several visits from members from our research group, with the collaboration of many volunteer workers from Algemesí Solidari.

The initial analysis deals with the historical, agricultural, geographical and climatic context of this small village, mostly inhabited by the large Ouedraogo family or clan, the Sawadogo clan, the blacksmiths clan and the two Peul clans, the Bary and Boly. Subsequently, a description of the settlement is offered, progressively examining urbanism, architecture and typical housing, which are closely linked and form part of the sociocultural and family scale of its residents. The materials and constructive techniques used both in the construction and regular maintenance of these dwellings are also presented.

An entire chapter is also dedicated to describing the precedents, vicissitudes and introductions of the design and construction of the secondary school in this village. This was in answer to demands of local residents, who felt it was a pressing need, and was carried out by Algemesí Solidari, in charge of supervising the entire process, from collaborative design to construction, furnishing and initial operation.


Two children among adobe walls, straw roofs and animal yards in the village of Baasneere.

12. The village of Baasneere

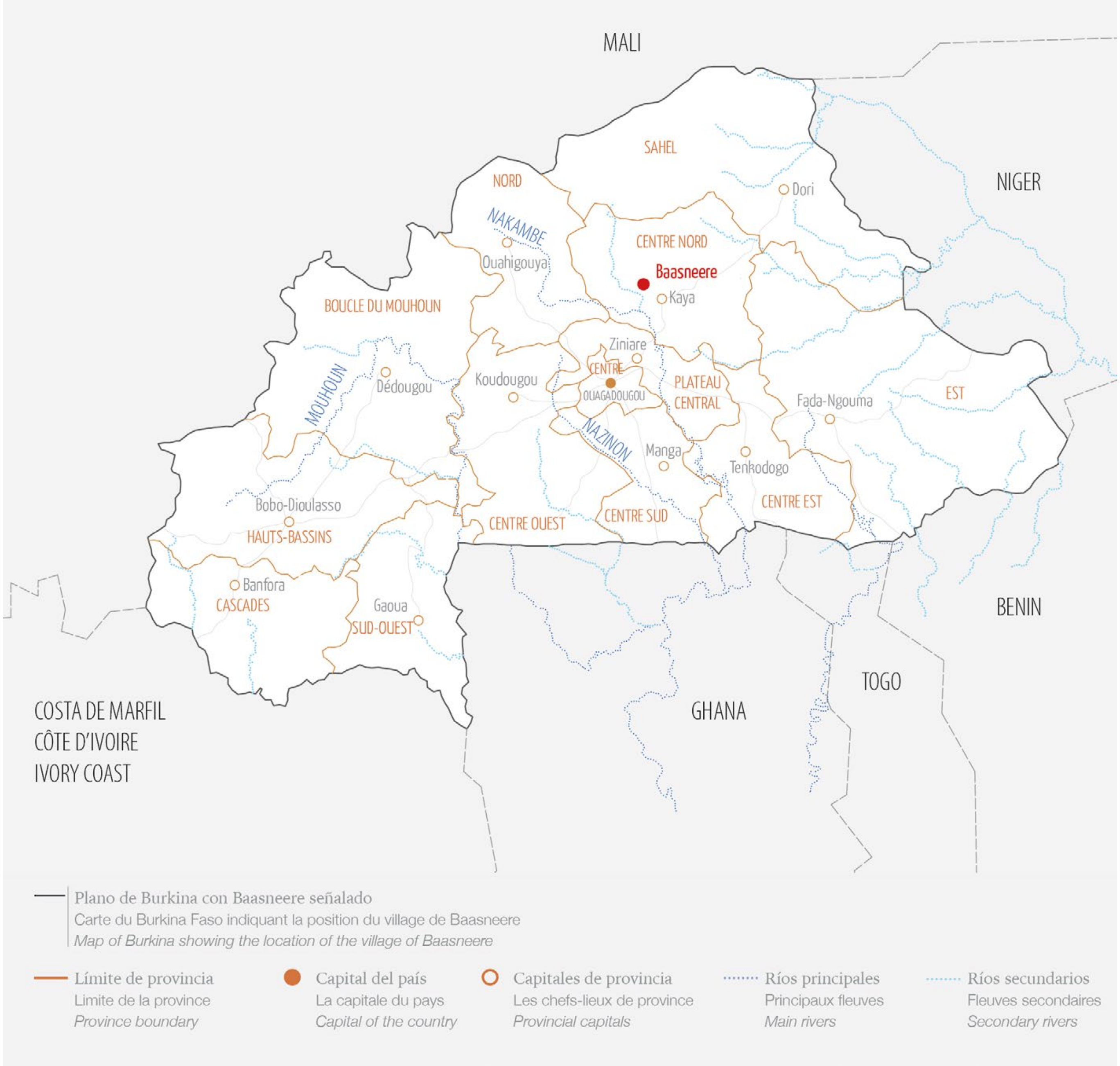
Baasneere is reached by a red dirt road which crosses the village and joins the cities of Kaya and Kongousi in a straight line. Prior to the colonization by the French this territory was part of the Mossi kingdom of Kaya, one of the five kingdoms of the Ouedraogo dynasty. Traditionally, kingdoms were organized into principalities, districts, villages, and neighbourhoods. Following the establishment of the colony this organization was transferred with relative ease to the French administrative system, dividing the country into 13 regions which in turn were divided into 45 provinces. Each province is composed of departments which can be rural or urban communes.

The centre-north region of Burkina Faso is made up of three provinces: Sanmatenga, Bam and Namentenga. The province of Sanmatenga has an urban commune, Kaya, as its capital, as well as ten rural communes. The province of Bam is organized in a similar way and its capital is the city of Kongousi. Baasneere is in the province of Sanmatenga, close to the border with Bam, and near the halfway point of the road joining both capitals. The route continues down the path, which is far from lonely. Travellers are constantly appearing on foot, motorbike, or bicycle, going from one village to another or to the fields beyond their homes. It has been raining and along the way water-logged areas, bumps and stretches of mud make it necessary to slow down. Children are often seen travelling in groups to the school in the neighbouring village. On the roadside, under the shade of trees, women and children can be seen selling fruit or bread. Compared to the isolated inland municipalities, the tracks joining the cities are thoroughfares where it is easier to exchange produce.

Baasneere spreads out on either side of the track and the section of road which crosses it is just another element in the village. In fact, the track and the market beside it could be considered the point from which the village was born and has developed. However, according to the elders the story of its foundation was very different: a community of autochthonous inhabitants or *têgâ-bisi* asked for help from the warrior Ouedraogo to defeat a common enemy and expressed their gratitude by rewarding him and his descendants with control of the land which had been the battlefield.

Some children in the neighbourhood of Natenga in Baasneere.

The feeling upon arrival, abandoning the straight line of the route, is one of complete disorientation. The unknown order of paths and buildings can only be assimilated by moving through them. The paths within the village are swamped with mud or even completely impassable due to the heavy rains of the last few days. It seems that in this season water follows the same route as people, forced between the fields which occupy as great a surface area as possible, while the paths are simultaneously tracks and streams. Upon arrival, all seems calm. However, quietly, groups of children start appearing from between the crops, behind bushes or tree trunks. Half-curious and half-cautious they approach to see, greet and welcome us.



Map of Burkina showing the location of the village of Baasneere.

Map of the Centre-Nord province showing the location of the village of Baasneere.

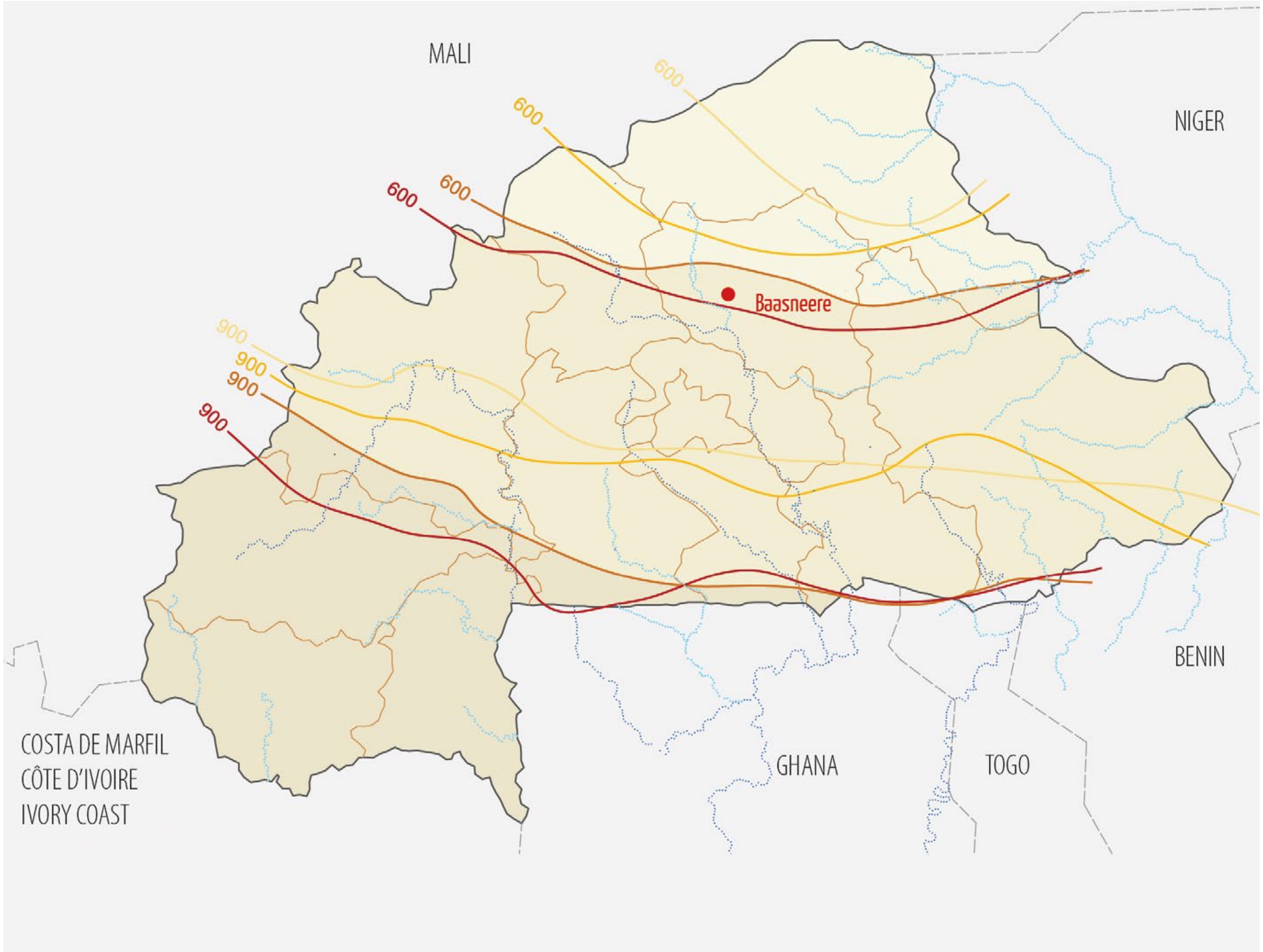
Between the crop fields and the expanse of red earth

Baasneere is located in the intermediate band of transition climate between the Sahel and Sudan climate zones. However, it is closest to the Sahel, with a similar climate given its location it the north of the region. It has an average temperature of 28 °C, with temperatures of about 40 °C in the hotter months and 20 °C in winter. The rainy season starts in late May when the first rain starts and lasts until mid-September. At that point the rain is torrential, reaching 207 mm, which means it rains more in three months than in climates such as the Mediterranean, although over a very short period. During this period the ground is constantly irrigated by abundant rain, while the other months of the year are completely dry.[129]

Due to this alternation the landscape changes dramatically in very short periods of time. In the months of June, July and August the surface is immediately covered with new plants. All the ground between the groups of houses is occupied by crops with paths between them. When it stops raining and the sun shines brightly everything begins to dry, leaving only cracked ground. In addition, February sees the arrival of the harmattan, a wind from the Sahara which covers everything in sand. The groups of dwellings, which had been protected and hidden among the large stems of the crops, are completely exposed once the space, occupied earlier by crops, has been transformed into an expanse of barren land. While the rain lasts the plantations of individual families occupy all the available soil along with the wild plants on the edge of the road.

The ground only becomes rocky at the south of the village and slopes slightly upwards to form a rocky mass. This is known as *bowal* (term of Peul origin), a lateritic soil resulting from the alteration of clays to form a hard shell-like surface, where nothing can grow. Any vegetation that grows here is wild and only a few small bushes grow nearby. Further away in the hills the first baobab trees appear, and the vegetation becomes denser, forming small forests. This is where the children, most of whom

[129] Climate-Data, Datos climáticos mundiales. “Climate Kaya”. https://es.climate-data.org/africa/bur-kina-faso/central-north/kaya-30399/#climate-graph (acc. 22/06/2019).



Distribución de zonas climáticas y evolución de las isoyetas entre 1931 y 2000. Fuente: Adaptado del *Atlas de la biodiversité de l'Afrique de l'Ouest*.
Répartition des zones climatiques et évolution des isohyètes entre 1931 et 2000. Source : Élaboration propre adaptée de l'Atlas de la biodiversité de l'Afrique de l'Ouest.
Distribution of climate zones and evolution of the isohyets between 1931 and 2000. Source: Adapted by the authors from the Atlas de la biodiversité de l'Afrique de l'Oues.

Distribution of climate zones and evolution of the isohyets between 1931 and 2000. Source: Adapted by the authors from the Atlas de la biodiversité de l'Afrique de l'Ouest.

Different landscapes in Baasneere through changing seasons.

Dwelling located in Baasneere between the crop fields in the neighbourhood of Tibtenga.

belong to the Peul ethnic group, traditionally keepers of livestock, bring the family livestock. It is also here, far from the village, that the residents of Baasneere usually bury relatives who have passed away.

In the valley between these hills, the land once again becomes workable and the red earth reappears. This soil, damper and more sheltered, is devoted to rice and corn fields. However, in the north the soil becomes lighter in colour, ochre or yellow, and almost becomes sand. Crops include millet, a diet staple in the village, as well as corn, beans, peas, peanuts and peppers. These pulses and vegetables, along with some fruits including melon, watermelon and bananas are the basis of the Baasneere diet.

Alongside the crops, the autochthonous vegetation is composed of tamarind trees (*Tamarindus indica*, *pusiga* in Mooré), carob trees (*Parkia biglobosa*, *dôagha* in Mooré) and

Baobab tree to the south of the village.

Crops of peas, okra and millet.

baobab trees (*Adansonia digitata*, *twégha* in Mooré), among others. These large species stand out in the flat landscape and can withstand extended periods of drought well. In surroundings such as these, and as in the rest of the country, it is understandable for the most widely used natural resource in construction to be earth and, to a lesser extent, plant fibres and timber.

The family as the basis of social organization

The population of Baasneere is among the 70% of inhabitants in Burkina Faso living in non-urbanized rural areas. As in many other villages in the country, tradition has been maintained despite social changes and it is still possible to see a system of social organization characteristic of the Mossi cultural group.

Individuals are grouped into families whose presence in the community is explained through the history of the creation of Baasneere: families of foreigners or *nakomsé*, descendants of the warrior Ouedraogo and therefore founders of the village, and families of autochthonous or *têgâ-bisi*, original inhabitants of the land. Apart from this cultural division, the community is organized into different social scales that go from direct family, family group or lineage, to the neighbourhood and all the residents of the village.

Each scale has a representative, usually the oldest male in the group, as consideration and respect for elders is a custom still maintained. Conflicts or agreements between neighbours are resolved by consulting these representatives whose function is to intercede for individuals under their care, negotiating their interests. In contrast to the privilege of the oldest male, the resolution of conflicts between dialogue and mutual agreement between parties helps this system, albeit hierarchical and undemocratic, to guarantee a degree of equality between individuals. The main families in Baasneere, whom the authors met during their stay in the village, are:

The Ouedraogo Family

The history of the foundation of the village explains why most of the families have the name or *sonde* Ouedraogo. Within this large group, sharing a common ancestor, the Ouedraogo families are divided between branches close to power or *nam*, who consider themselves to be direct descendants of the first founder and as such the families of *nakomsé* or nobility of the ethnic group, and the branches of the family far removed from the chief and the privileges of government and made up of common people or *talsé*. To this group we must add the families sharing the name Ouedraogo but who had settled in the village following its foundation, after arriving from other parts of the Mossi kingdoms and who therefore are not directly related to the chief's family, despite sharing the common ancestor who founded the ethnic group. The chief of the neighbourhood of the *nakomsé*, chief of the Ouedraogo family, is always the *naaba* of Baasneere, in charge of arbitrating conflicts between neighbourhoods and officially hosting and representing the village before the administration and foreign visitors.

Ismaël Ouedraogo looking at corn fields.

The Sawadogo Family

In addition to the Ouedraogo, the other great family in the village is that which bears the name or *sonde* Sawadogo, which means “rain cloud”. These are families of *têgâ-bisi* or “children of the land”, the families autochthonous to the region. The chief of the neighbourhood of the *têgâ-bisi* and of the Sawadogo family is the “chief of the land”, in charge of all matters relating to work on the crops. The chief of the autochthonous population is also second-in-command or main advisor to the *naaba* of the village so that between both the representation of most of the residents of Baasneere is ensured.

The alliances and links between these two large family groups form the basis of the social organization of the village.

Courtyard of a house in the Karongo neighbourhood.

Diagram of social organization characteristic of Mossi culture.

Woman at Baasneere.

Families of blacksmiths

Apart from these two groups, in Baasneere there is also a third social segment characteristic of the Mossi ethnic group: the families of blacksmiths or *saanba*. These live in more isolated locations in a neighbourhood far from the centre of Baasneere, with their wives, the village potters. These families of blacksmiths and potters are in charge of producing agricultural tools, adornments, large jars and bowls for the other people in the village.


Man metalworking.

Woman making pottery in the Basnekoudougou neighbourhood.

Man at Baasenere.

Peul family in the courtyard of their home.

Bary and Boly Families

In the village there is also a nucleus of families of the Peul ethnic group, the Bary and the Boly. The Peul were traditionally a semi-sedentary and livestock-raising people who had lived with the Mossi on their land thanks to an alliance signed in the past between a Peul chief and a Mossi chief. These families are settled in Baasneere and have abandoned their nomadic tradition. However, they continue to raise livestock and at the end of the day their herds of goats and zebus can be seen in the courtyards of their homes.

Courtyard of a Peul family.

Newly arrived families

Finally, some families in Baasneere, such as the Betlem family, originally from Yatenga emigrated from other parts of the Mossi kingdoms and only arrived in the village relatively recently. All these families are divided into branches of direct kinship grouped into the same part of the village to form groups of dwellings or, depending on the size of the family, neighbourhoods. In the village, social organization determines the administration and policy and can also be physically applied to the construction of housing. How society is organized not only determines the village's political organization but also its actual physical layout.

Woman carrying objects on her head on the streets of Baasneere.

13. Urbanism and architecture in Baasneere

Family as the basis for urban organization

Baasneere was developed through the growth of the homes of the different families on either side of the path and around the market. This spontaneous unplanned development is a response to the way in which the family, and in turn the house, change. There is a direct relationship between how the territory is occupied and how the dwelling is built and inhabited.

This is a common feature in traditional architecture, especially in the construction of housing in West Africa. The house as a living being which grows and develops, as something which confirms meaning and can be loaded with significance, and which is part of the interpretation of the world and life, has been widely discussed in the bibliography.

> This architecture, born of a profoundly spiritual and productive relationship between inhabitant and inhabited, space and habitat, welcomes sociability and connotes the existence of the group in its continuity [...] Each house reveals itself to be a tool, a work of art and a spiritual place at the same time. It is built according to the model of the human body to shelter, protect, receive, be reborn and survive; to give aesthetic pleasure, to dream in peace, to create a social ground, to facilitate communion with ancestors and deities; but also, to be in tune with the forces of nature. An inhabited house is, like adult humanity, a house in the process of procreation, a house in the making. It is a living element which grows or diminishes, which requires regular maintenance, repair, and care like a sick person, and which dies when it is left to fall into disuse. The house is neither a means nor an end in itself; it is both a constructed space and a building space – a building in which, with which and thanks to which one lives.[130]

Along with this natural reflection of the way of life in built form, the Mossi tradition awarded each family its place in the village, a physical place which was a part of the territory and a figurative one which represented its role in the history of its foundation. These “places” seem to have been commonly accepted as something that “has to be” with the characteristic certainty of tradition. Thus, there seems to have been an agreed harmony which over time also became natural in the way that the land is occupied. The

[130] Bourdier & Minh-ha 2005: 15.

View of the Natenga neighbourhood in Baasneere.

earth, which is cultivated and used to build on, is awarded by the chief of the people to the chiefs of the neighbourhoods and by them in turn to the chiefs of each family.

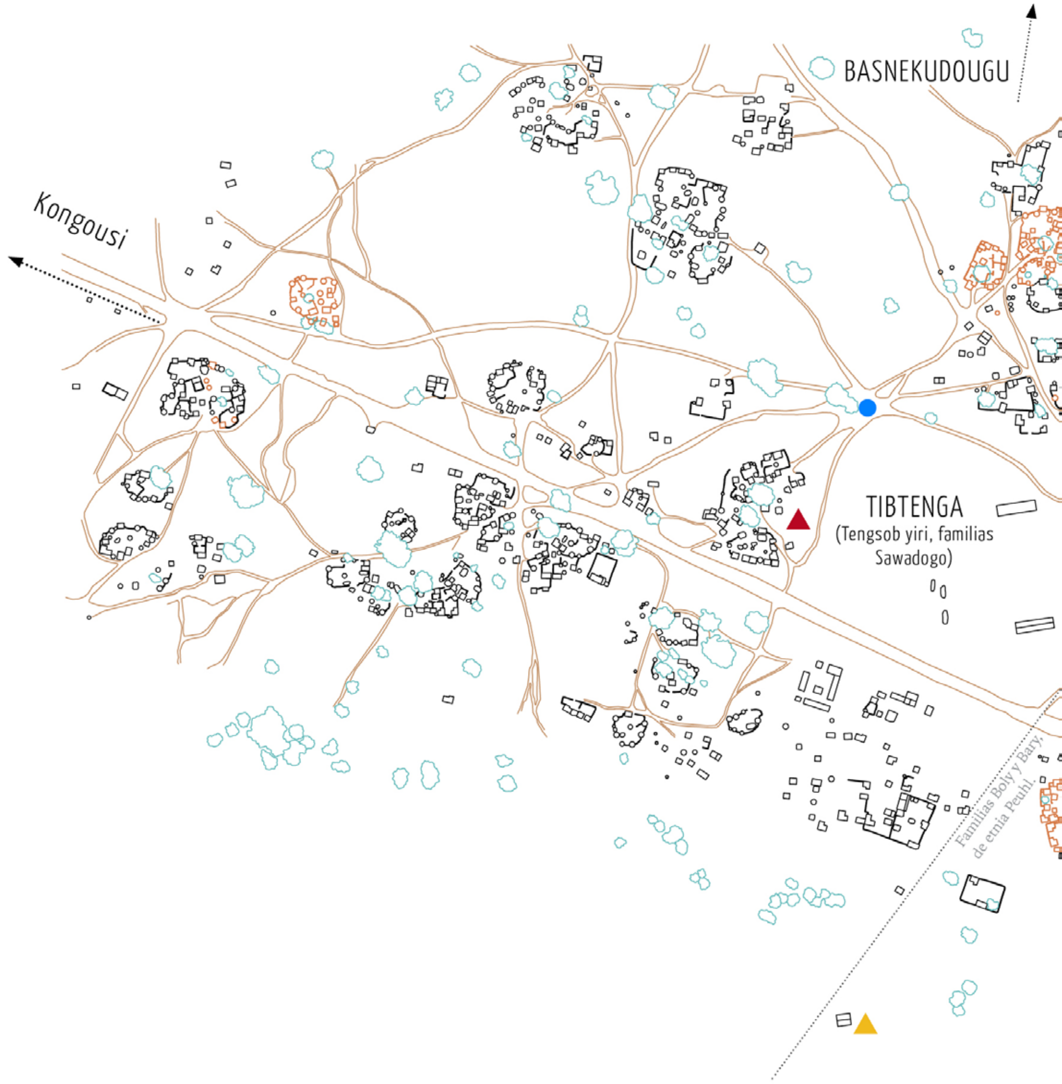
However, “chief” is a European concept[131] In fact, these men who are in charge of the organization of the village are the elders of families and tradition makes them responsible for their own. Therefore, the relationship is not one between “leaders” and “subjects”, but a “father-son” family relationship guaranteeing fair treatment and equality in the distribution of the land. The elders had to ensure that everyone had enough land to live on, which explains the harmony that can still be perceived in the village.

[131] Bourdier & Minh-ha 1985, op. cit., p. 17.

Aerial photograph of the village of Baasneere and its main neighbourhoods. Source: Google Maps.

Most of the groups of courtyards are clusters. A main road leads to the group, and from there, secondary paths lead to the individual dwellings. Within the complex itself, the courtyard connects the different individual units. In this type of architecture, the simile of the family as a large tree finds its literal physical expression, as the different branches are born from the common root. As the family grows, so does the group. Sometimes, due to a lack of space or a decision by the elders a complex can be separated at a given point to leave space for a new group in time. However, the separation of complexes does not imply a separation within the family and family relationships between the different groups and neighbourhoods still survive.

Baasneere has therefore traditionally been a settlement which was not designed but rather came to be spontaneously, based on the village's social organization, focused on



xx Plano de Baasneere
Plan de Baasneere
Plan of Baasneere

Límite entre barrios
Limite entre les quartiers
Neighbourhood boundary

Casos analizados
Cas analysés
Cases analysed

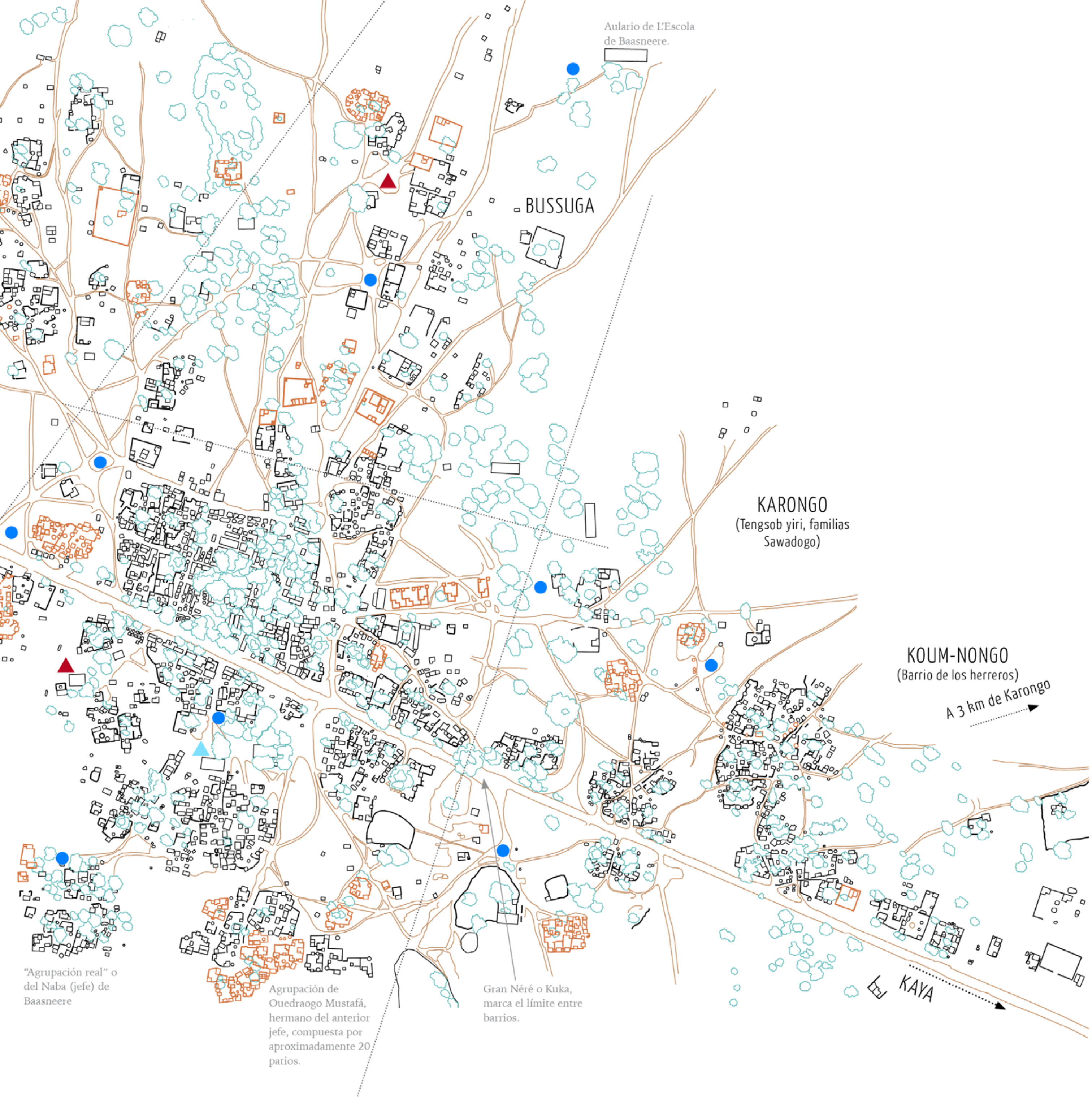
Pozo
Puit
Well

Mezquita
Mosquée
Mosque

Iglesia protestante
Église protestante
Protestant church

Iglesia católica
Église catholique
Catholic church

Plan of Baasneere.


Aulario de L'Escola
de Baasneere.
BUSSUGA
KARONGO
(Tengsob yiri, familias
Sawadogo)
KOUM-NONGO
(Barrio de los herreros)
A 3 km de Karongo
KAYA
"Agrupación real" o
del Naba (jefe) de
Baasneere
Agrupación de
Ouedraogo Mustafá,
hermano del anterior
jefe, compuesta por
aproximadamente 20
patios.
Gran Néré o Kuka,
marca el límite entre
barrios.

View of the Natenga neighbourhood in Baasneere.

the family and supported by the culture and customs of the ethnic group. The description of the main neighbourhoods below shows how this organization is still maintained.

Natenga

This is the *nakomb yiri* or neighbourhood of the *nakomsé*. The name of the neighbourhood is composed of the diminutive *na*, from *naaba* or "chief", and the word *tenga*, which means "earth". Literally, Natenga translates as the "land of the chief", that is, the neighbourhood of the *naaba* of Baasneere. This seems logical considering that, according to tradition, the chief of the village must always be a descendant of the founder, Ouedraogo, and will therefore always be a man chosen by the residents of Natenga. This neighbourhood occupies the centre of Baasneere, along the road and opposite the market. Over time,

View of a housing cluster in Natenga, Baasneere.

the Ouedraogo family was divided into three main branches which have formed three recognizable groups of dwellings.

The one furthest away is the "royal group" or that of the chief of Baasneere. This is where the *naaba*'s closest relatives live. Outside, by the entrance, on a large porch shaded by trees, the chief welcomes his advisors, the chiefs of the other neighbourhoods or any visitors who have just arrived in the village. The location is well-chosen, as it is where the land begins to elevate towards the hills to the south of the municipality in a meeting place which looks over the entire village.

The other two major groups in Natenga are the dwellings of the relatives of the chief or his predecessor. The large size of the groups reflects how long these families have been in the village and the custom of establishing large residential complexes. As well as the groups of the Ouedraogo family, almost on the border of Natenga with the next neighbourhood, Tibtenga, there are groups of housing for the families from the Peul ethnic group. The Boly family, whose group is made up of three complexes, is north of the road; while the Bary family has four courtyards south of the road. The location of the dwellings of these families beside the road and inside the neighbourhood of the *nakomsé* may be due to their having settled in the village some time after its foundation.

Tibtenga and Karongo

Situated on either side of Natenga, we find the neighbourhoods of *têgâ-bisi*, the "children of the land" or autochthonous settlers of the region. These are made up of the groups of housing of the Sawadogo families. Karongo is the *tengsob-yiri*, that is, the home of the "chief of the land", whose group of dwellings, like that of the chief of Natenga, is separate from the rest of the family group. It is composed of two courtyards, one inhabited by his family and the other by his younger brother's family. A few metres beyond this point, we find the housing complex belonging to one of his sons, who has left the family group to set up his own. The size of the groups in these neighbourhoods, although generally smaller than those in Natenga, is equally striking, reflecting the large size of these families and the length of time they have been in the village. These are traditional neighbourhoods in which most dwellings follow the traditional Mossi model.

Bussuga

This neighbourhood north of the market has traditionally welcomed recent arrivals to the village, such as the Betlem family, originally from Yatenga. In addition, Bussuga is the centre of the urban development of Baasneere as it incorporates the healthcare buildings and new buildings of Algemesí Solidari's *Escola de Baasneere*.

Basnekoudougú

According to tradition this was the old Baasneere, the village of autochthonous inhabitants who requested the help of the warrior Ouedraogo to be freed from a common enemy. Therefore, like Tibtenga and Karongo most of the residents are from *têgâ-bis*i and bear the surname Sawadogo.

Koum-Nongo

This is the neighbourhood of the blacksmiths or *saanbas*, in charge of manufacturing agricultural implements. Their wives are the pottery artists who manufacture the clay jugs and bowls. The neighbourhood is 3 km to the north of the neighbourhood of Karongo. Traditionally only the families from this neighbourhood could work at both trades, as blacksmiths and potters. However, this tradition is no longer so strictly observed, and potters can be found in dwellings near the market in the Natenga neighbourhood. In addition to these, other neighbourhoods further from the centre, such as Tamiga or Bauboka several kilometres away, belong to Baasneere.

Path to Basnekoudougou.

View of Koum-Nongo, blacksmiths' neighbourhood.

Traditional fabrics sold at the market.

The market

Every three days people from all neighbourhoods gather in the market in the centre of Baasneere. In addition, if the market day happens to be a Sunday, then the "Great Market" is held, where traders also come from other nearby locations to sell their products. Fruit, vegetables, meat, and livestock are sold in the market, as well as cotton fabric, bowls and ceramic pots, agricultural implements, and furniture made with reeds. On market days, bakers fire up their ovens and families carry cooked products such as fritters or biscuits to their stalls. Some foodstuffs such as millet, peanuts or corn are not sold as often in the market as each family owns their own fields and only produce for themselves unless there is a glut in the harvest.

Ceramic vessels sold at the market.

Peul family in the courtyard of their home.

The market is made up of a series of parallel and perpendicular streets among which stalls are set up. Stalls were traditionally built with simple tree branch structures on which braided straw mats are placed. However, they are now being built with metal tube frames and sheet metal enclosures. Wooden trunks on the ground mark out the location of individual stalls and provide sellers with somewhere to sit.

Women from Baasneere.

A market day in Baasneere.

A market day in Baasneere.

On days when there is no market, the wooden structures are empty, and groups of children can be found playing in an artificial forest of branches and trunks. On market days, however, the space is completely transformed. The once-chaotic structures are filled with the products of each stall and the streets between the different trading locations are once again recognizable.

This entire area is protected by the shade of the trees. On market days, which last all day, the houses are practically deserted, and the people all spend the day at the stalls where each family has a spot for trading. The market is the public space for relationships, for finding out and discussing the news, and making agreements or contracts between families. It is where the social life of the village takes place.

Two women at their market stand.

A family working their fields next to the school in Baasneere.

Public facilities

In Mossi traditional architecture, specifically in Baasneere, there does not appear to have been a public building typology. The meetings, assemblies and ceremonies of elders were held under the shade of a tree or in wooden shacks with braided straw mats, found beside houses. The daily activity took place in courtyards, where the children were educated and taught.[132]

As in the rest of Burkina Faso, schools are influenced by the French, who established their educational system in the country. There is a primary and a secondary school in the village with buildings built through international cooperation projects. As these buildings need larger spans than those used in domestic architecture and as they may have been commissioned from construction specialists, the schools have been built using cement block walls and covered with corrugated sheet metal affixed to metal

[132] Zongo 2004, op.cit. 134.

The Grand Mosque in the Natenga neighbourhood.

structures. An exception is the Algemesí Solidari secondary school where CEBs were used in the village for the first time.

The same occurs with religious buildings. In Baasneere there is a Catholic church, a Protestant church and three mosques (a main one and two smaller ones). The Catholic church is a large simple building, with cement block walls, metal trusses, and sheet metal covering the building. The mosque buildings follow a design also used in surrounding villages and other parts of the country and new materials have also been used in the construction. Both churches and mosques

Exterior of the Catholic church in the Natenga neighbourhood.

are buildings which, unlike traditional buildings, have been commissioned from builders and built following a pre-established design.

The healthcare buildings are in the north of the village in the neighbourhood of Bussuga. These are also cement block buildings with corrugated sheet metal roofs, although their layout is reminiscent of that of traditional houses. The health centre, dispensary and maternity clinic are built around an open central space, protected by large trees under which a large porch has been built.

Wells in the Natenga and Karongo neighbourhoods.

Wells are another important facility in the town. These constructions are the result of international cooperation projects or projects carried out by the Burkinabe government. Each neighbourhood now has one or two wells where women and children are often found, as they are in charge of carrying water home. Although these are all recent constructions, manual wells were also a part of traditional architecture.

Two men walking in the outskirts of Baasneere.

Wells in the Natenga and Karongo neighbourhoods.

Traditional well next to the path to a house.

Domestic space in Baasneere with a courtyard, tree, exterior kitchen, hut and connected rooms.

14. Housing in Baasneere

Most buildings in Baasneere are residential. Public places, both inside and outside the home, have traditionally been set up outdoors under the shade of a large tree or the shelter of a shack built with trunks or braided straw mats. The vernacular architecture of the village is therefore mostly domestic, while public facilities such as schools, health centres and faith centres are the result of external influences which have brought with them their own constructive systems.

Like the traditional habitat of Burkina Faso, the traditional dwelling of the Mossi ethnic group, and that of other groups in the region, is an economic, ritual and religious unit supervised by the head of the family, usually the eldest male member. The family unit which lives in it and has built it is usually made up of this man and his younger brothers, along with all their wives and children. The adult sisters and daughters must move to the homes of their in-laws, although they maintain links with their biological family.

The dwelling is an economic unit, with its occupants working the land and distributing responsibilities and crops equally. It is also ritual and religious because depending on traditional beliefs it is used for worship and for celebrating ceremonies to honour the family's ancestors, with the family elder as intermediary.

As in many other cultures in West Africa, the traditional residential unit is a complex made up of a series of individual constructions built around a central space to form a courtyard joined with shoulder-height walls. In Mossi architecture these individual buildings tend to be round constructions – *roguilga* – with adobe walls and conical thatched roofs, or to a lesser extent, rectangular constructions – *rogo* – also with adobe walls and flat thatched and earth roofs. As the circular shape dominates individual constructions, the outline of the complex also tends to be circular.

Each individual unit is occupied by a family member. Sons under the age of ten can live with either their father or mother while unmarried daughters can live with their mother. Therefore, men and women, young and old, each have their own building regardless of age. These individual units are what in European dwellings would be described as "rooms". The great difference between both models is that in African architecture, specifically Mossi architecture, the connecting space between these "rooms" is not merely a connecting space, but a communal living space in the open air, and has a series of privacy filters. The traditional dwelling is therefore closed to the outside of the complex but open inside. The courtyard is the centre of family life, the most

Roguilga, circular construction typical of the traditional Mossi house.

important space and the determining element of the dwelling floor plan. However, the interiors act as shelter and are more closely connected to the individual.

Each complex, with its layout of individual constructions around a courtyard, is therefore the home of a family unit. Individual elements can also have their own private courtyard or be grouped within the central space into secondary courtyards reserved for the daily activities of the person or family branch occupying them. Thus, a grading system in ascending order is established for the privacy of the spaces (village, neighbourhood, group of courtyards, family courtyard, individual courtyard, and individual construction).

Shacks used to provide shade and to store the greenery on them are also commonly found in courtyards. These structures of wooden trunks and branches are sometimes covered with

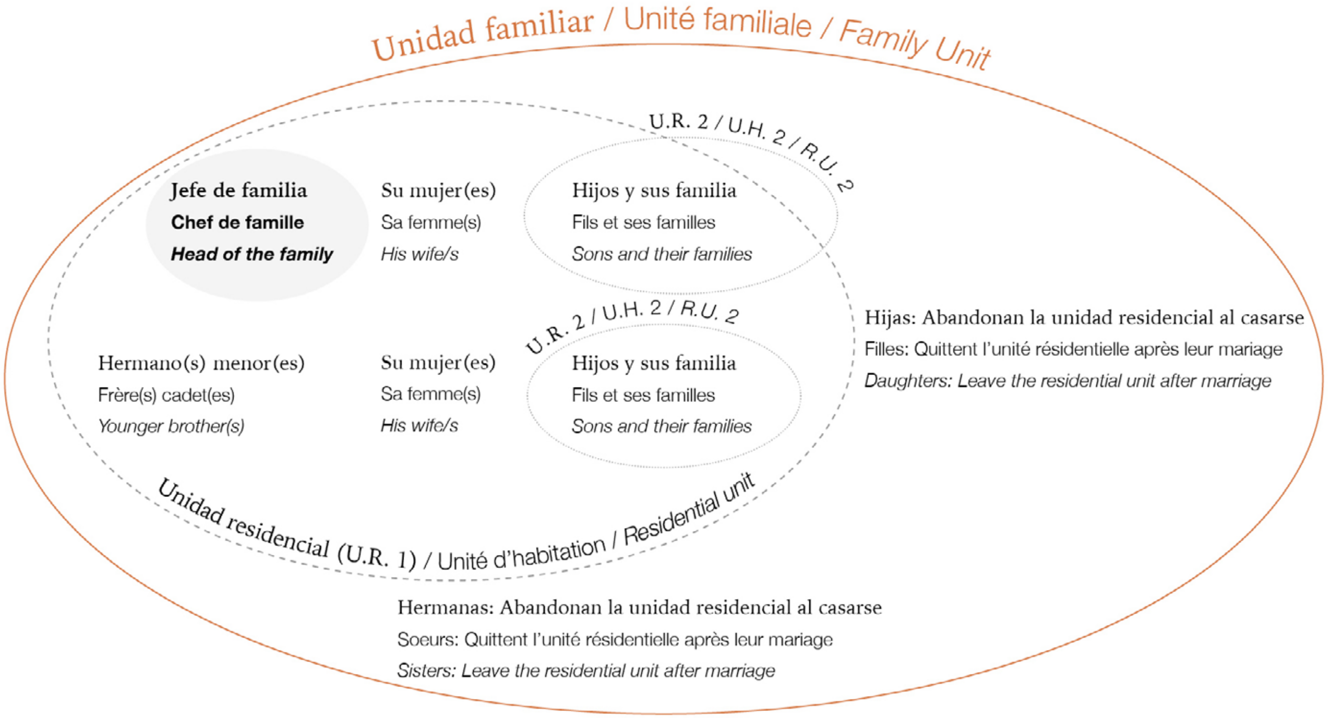


Diagram of the traditional family unit.

braided straw mats and placed as protection beside the individual buildings or by the entrance to the courtyard or group of courtyards. In this case the shacks are larger as they are the spaces traditionally occupied by the family elders from where they can monitor both the interior and exterior of the dwelling and welcome any visitors.

In addition to the individual constructions and shacks, the other building typology in traditional Mossi architecture is that of granaries or *tudgou*. These large circular constructions are made up of a plant wall of braided straw mats separated from the ground on a framework of wooden branches. The upper section, where the grain is poured in, is protected once the container is full by a conical roof of braided straw identical to that used in the rounded constructions or *roguilga*.

These constructions are not usually found in courtyards but in the fields or communal spaces within the complex. This is for protection from

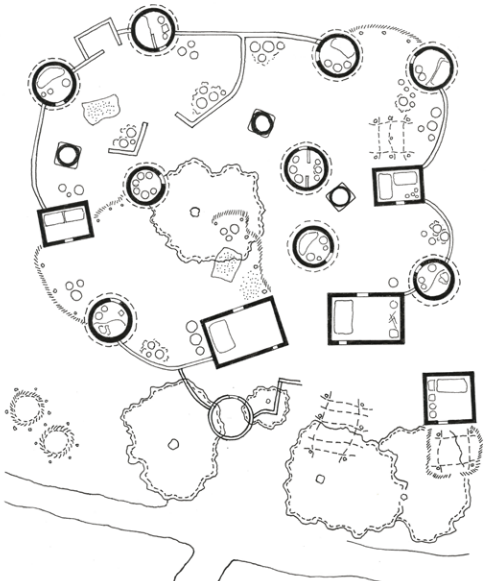
View of the interior of a courtyard.

View of the entrance to a courtyard.

any possible fires within the courtyards and because in most cases granaries are shared by different branches of the family who work on the same land.

The adobe walls

The process for building the walls of the two main typologies, *rogo* and *roguilga*, consists in drawing the outline of the dwelling, excavating to the level of the interior floor, slightly below the exterior level, and beginning the construction of the adobe walls directly on the ground, which has been previously moistened to reduce the absorption of water and improve the adherence of the mortar. A small adobe step is built at the



Drawing of a traditional dwelling in Baasneere.

Secondary courtyard within the housing complex.

A woman at the entrance of her housing unit.

Sheds at the entrance of the buildings.

Shed next to the entrance of the family courtyard.

Granary next to the entrance of a grouping of courtyards.

Adobes made in the courtyard of a house.

base of the door opening to prevent water from entering in rainy months. The earth extracted manually from the inside is kept and later used to render or add protective layers to the flat roof.

The size of adobe bricks in Baasneere is approximately 30×15×6 cm and they are laid out in stretcher bond using earth mortar, usually the same mix used to produce the adobe but watered down. In order to protect the base of the wall it is expanded either inwards or outwards and, in most cases, the first two courses of adobe are doubled to form a base or create a small tapered earth plinth.

Traditional roofs

The conical braided straw roof is used to cover the *roguilga* or rounded constructions and the *tudgou* or traditional granaries. This is a frame of wooden branches to which braided straw mats are tied. The construction process for this type of roof begins with the timber framework. This structure is generally built on the ground but once it is complete it is raised and placed on the adobe walls. Firstly, a circumference is drawn on the ground with a diameter larger than that of the building wall, as the roof must project, forming a small eave to protect the adobe wall from rainwater. The branches are placed radially on the circle drawn so that the upper ends cross at the centre where they are tied together to form a cone.

View of a traditional conical roof.

The branches are tied together with rope made of the flexible stalks of the *berenga* plant, which grows locally. Loose stalks are used individually as ties or braided together to create thicker rope. This type of rope is tied in a spiral around the cone of the branches so that both individual branches and the rope spiral are tied using plant fibre. Thus, each branch is attached to the frame at several points of its elevation, creating a resistant lightweight structure. This structure is then covered with braided straw mats to which several layers of straw are added. All these layers are tied together with rope in a spiral pattern throughout the structure. To finish off, several rope rings are manufactured and placed on the final layers of straw and fix them down.

Flat braided straw roofs receive a similar treatment. In this case, branches with a larger section are laid down about 50 cm apart to cover the distance between the adobe walls, usually 2 to 2.5 m long. Thinner branches are placed perpendicularly on this main structure to form a dense framework. Several layers of straw mats are added, braided, or simply tied together, before being tied to the branches of the structure. This straw layer is protected with several layers of mud, normally using the excavated earth in the mix to create the interior flooring of the dwelling.

The repair of the houses

Rain has traditionally been the main cause of deterioration of buildings in Baasneere. The thatched roofs of the *roguilga*, the mud renderings of the adobe walls and the flat roofs of the *rogo* and the increases at the base of the walls are traditional architectural devices designed to protect from rainwater in the three months of the wet season. These protection elements suffer the most deterioration and must be repaired every one or two seasons. Torrential rain can even affect adobe walls, causing the structure to collapse into ruins. In these cases, repairs are not enough and it becomes necessary to reconstruct collapsed buildings.

The ideal time to gather materials for construction is after the rain when the soil is still damp and can be worked on, when there is abundant vegetation and the work in the fields has finished. All that is left is to wait for the harvest. Adobe bricks are manufactured and left to dry; branches and the straw that is to be braided to build walls and roofs are collected. Although the rain damages the buildings it also provides the material needed to repair them in a natural cycle.

The water-damaged elements of the dwelling are then inspected to decide which repairs are a priority and which can be left until the following season. It is also decided which housing units require reconstruction or how many new ones will be needed to accommodate a growing family. Like the construction of the dwelling, the repairs and maintenance of the building were and continue to be just another family task which along with agricultural work depends on the rainy season. All members of the community take part in sowing and harvesting, collecting materials and the conservation and reconstruction of the dwellings in an annual cycle conditioned by the arrival of storms in summer. This is part of a traditional way of a life where annually each family gets ready to prepare the dwelling and ensure its maintenance during the dry months which follow the wet season.

Inner view of a traditional roof.

Male pupils from the new secondary school in Baasneere.

15. Algemesí Solidari and the school of Baasneere

The NGO Algemesí Solidari was founded in 1991 to raise awareness in the town of Algemesí and to contribute to creating a fairer, more charitable, and empathetic world on a local scale. However, apart from its local action, this NGO has also carried out international cooperation projects in the village of Haku (Nepal) and in the refugee camps of Athens and Lesbos and continues to develop projects in the village of Baasneere in Burkina Faso.

The cooperation with Baasneere began with the construction of a well at the request of a group of women from the village and in collaboration with the counterpart *Buud-Bumbu de Bao/ Baasneere* (A3B) in 2011. Since then, the relationship between the two villages has grown closer with the subsequent twinning between Algemesí and Baasneere in 2012, the rehabilitation of the health centre in 2013 and the construction of a secondary school, currently ongoing.

This last project, *L'Escola de Bassneere*, will allow the younger locals to continue their studies without having to travel 30 km to the closest school, which in most cases led to students being unable to continue their education. The project began as participatory based on the ideas developed in the workshop *Proyectando y construyendo en Burkina Faso. Propuesta para una escuela secundaria en Baasneere*, organized at UPV by teachers Fernando Vegas and Camilla Mileto and by the directors of Algemesí Solidari, Xavi Ferragud and Juan Vicente Maravilla, in July 2014.

This workshop, which was attended by 60 students, resulted in 12 different proposals for the design of the school. These ideas were discussed with the representatives of Baasneere and the heads of *Buud-Bumbu de Bao/ Baasneere* (A3B), during August 2014, with an exhibition of panels where the population could express their opinion about the school. From then on, the project was developed in collaboration with a group of volunteer architects and the supervisors of both associations, led by the HAC-90 architecture studio, until the necessary permits were obtained to build the school in October 2016.

Administration building under construction, Phase 2 of the project.

Advertisement for the twinning of Baasneere and Algemesí.

The project design was proposed based on the traditional architecture in Burkina Faso, in keeping with the place and its customs and following the criteria of sustainability in its three fundamental pillars:

- Socioeconomic sustainability, using local materials, encouraging local participation in the work, and promoting low electricity consumption in the construction process.

The collaboration between Algemesí Solidari and the village of Baasneere began with the construction of a well.

- Sociocultural sustainability, as it is based on the characteristic cultural foundations of the community, and on its constructive techniques, trades, and crafts.

- Environmental sustainability, as it integrates into the landscape and adapts to local climate conditions.

The project for the secondary school included the construction of a lecture hall with 3 class-rooms and auxiliary buildings for administration, library and laboratory, as well as 5 housing units for the teachers of the school. The school is made up a series of modules built simply using a system of walls and vaults built with compacted earth blocks (CEBs). Its modulation was intend-ed to make possible its progressive construction in different phases that were economically via-ble depending on the funding available. The use

School classrooms, built during Phase 1 of the project.

of the CEB construction technique was chosen because it is a durable low-cost constructive solution that is easy to maintain and can be produced by unskilled labour. This technique can be understood as the technical evolution of traditional adobe. Each module is protected by a metallic cover which guarantees the conservation of earthen construction and prevents indoor overheating as it is separate from the vaults and allows continuous ventilation.

Due to its design with independent elements, the project has been structured into annual periods suited not only to the availability of funds, but also to the agricultural production cycle and rainy seasons in Baasneere, so that it was possible to start using the buildings as they were constructed.

The project was managed and organized through successive trips by members of the NGO to the village of Baasneere. The project

Interior of the administration building under construction, Phase 2 of the project.

began with a visit to the Burkina Faso Minister of Education, the Mayor of Kaya, the Kaya Polytechnic, and the various traditional chiefs of the villages whose children would be students at the future school. Finally, the chiefs and inhabitants of the Baasneere village were the ones who provided the land needed to start the construction. For the development of the work, a local construction company with experience in the use of CEB was contacted. The Catalan architect, Albert Faus, who lived and worked in Burkina Faso, would be in charge of directing the work of the first phase of construction.

However, the development of the works represented more than just a simple construction agreement and professional development. At the same time, it became a process of learning about earth construction techniques. It was also a way of making the neighbours of Algemesí aware of the living

CEBs stored outside the school ready for the next construction phases.

conditions of the inhabitants of Baasneere, thus strengthening the town-twinning agreed in 2012. In this sense, successive stays organized since the beginning of the works, in 2016, 2017 and 2018, have allowed groups of students and professionals from the NGO to live together with the inhabitants of Baasneere in order to collaborate in the direction and supervision of the building works. In this way, a close relationship has been established between the community and the volunteers of Algmesí Solidari.

The first three phases of construction of the project have now been completed, including, firstly, a building consisting of two classrooms, already in use, secondly, the school administration building and the latrines; thirdly,

Students of the new school in Baasneere at the end of classes.

School classrooms, built during Phase 1 of the project, pending the basement of the building.

housing for teachers. In addition, a well has also been built, close to the school and financed by the Kaya administration, which will allow the children to have access to water without leaving the school area.

The latest news from Baasneere in 2022, however, reports an increasingly serious insecurity situation due to incursions and attacks by extremist groups throughout the northern region of the country. Despite this, the intention is to continue with the last phase of the project and build a library for the school.

From the beginning of the project and throughout its development, the initial ideas have changed as they have been forced to adapt to the unforeseen circumstances arising and to the conditions of the village as witnessed in the successive stays. This has turned the project into a living and dynamic process attaching value to both the goal and the path to it.

Female pupils from the new secondary school in Baasneere.

PART 4. COOPERATION PROJECT

This final part of the book focuses on the cooperation project Standing With Burkina, a collaboration between the Universitat Politècnica de València and Algemesí Solidari, as part of the project for *L'Escola de Baasneere*. This project aimed to provide technical support in the construction of vaults in the design and construction of future educational buildings in Baasneere. The construction of vaulted buildings aims to avoid the use of timber, with its increasingly dwindling supplies, adapting to the environment in material and architectural terms as well as from a cultural, social and economic standpoint. The project consisted of the following phases: 1. a study of the local situation; 2. research and scientific experimentation at UPV on tile vaults built using CEBs and alternative mortars; 3. design of activities for training, awareness and participation (cooperation workers, local builders, young people and children); 4. professional training and technical empowerment of the local population; 5. social participation activities; and finally, 6. dissemination of results.

The aim of the project was to offer technical scientific support for the design and construction of a sustainable project in environmental, sociocultural and socioeconomic terms; to contribute to the technical training of young people in Baasneere, offering them employment in the construction of the school to promote their professional development, involving the population in this process of construction, providing them with a sense of ownership, and facilitating the integration of the school into the community.

Detail of the process for incorporating ceramic tiles into a tile vault.

16. Research and scientific and training support for a cooperation initiative

Since 2014, the *Res-Arquitectura* group from the Universitat Politècnica de València has been supporting Algemesí Solidari in the development of *L'Escola de Baasneere*. Over these years, the cooperation between both institutions has taken the shape of earthen construction courses to train NGO workers, workshops with architecture students for the design of the school, and support during the process for the design and construction of the building. The cooperation project was born against this backdrop, as yet another step in the joint work of the NGO and the University.

It is a research and cooperation project which mainly aims to provide scientific and technical training support to involve the residents of Baasneere in the work for the construction of the vaults used in the school. The chosen technique uses compressed earth blocks (CEBs) to construct a building that is more sustainable, comfortable, and healthy than the conventional constructions which use a format and industrial technology imported from Europe.

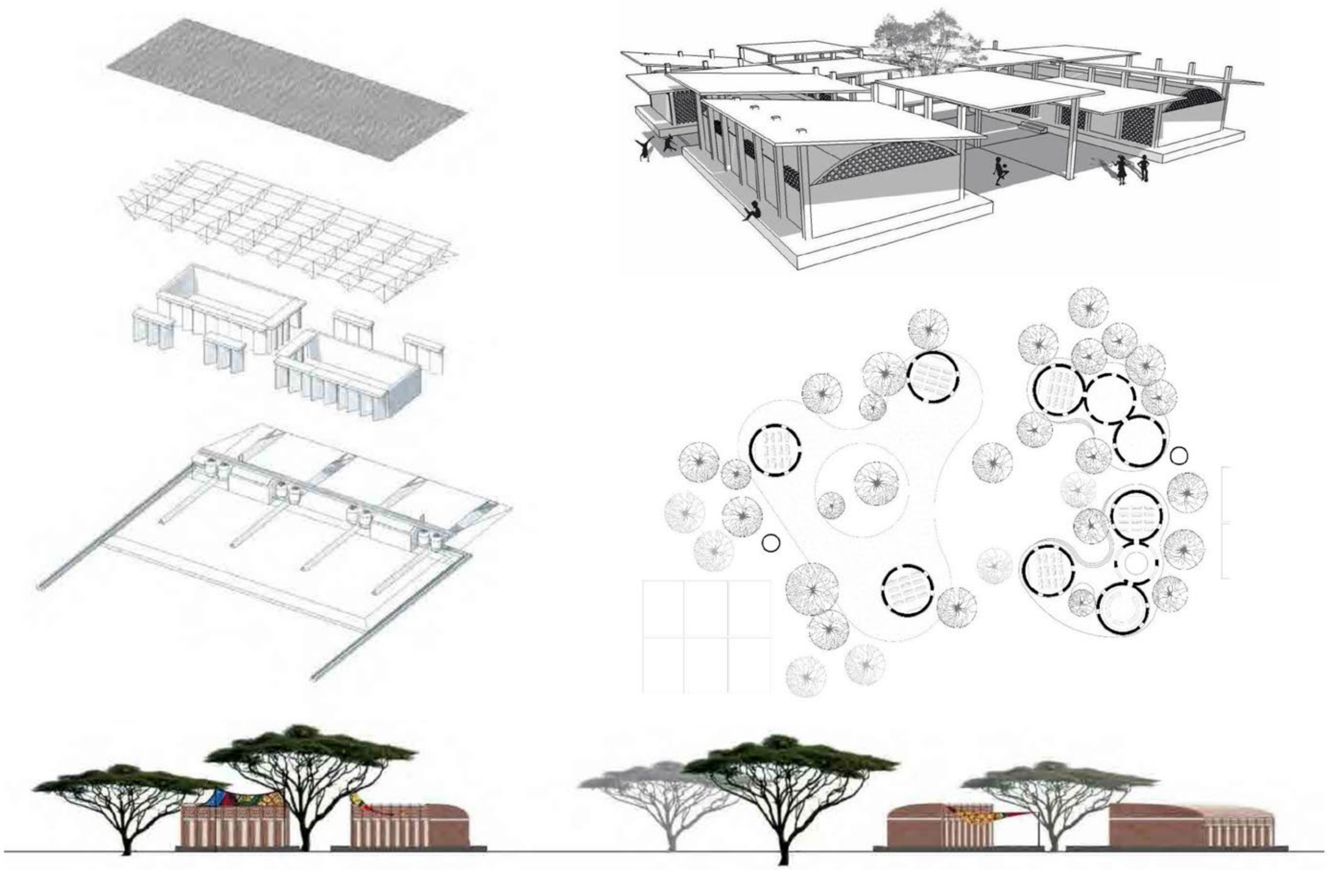
Project objectives

This initiative is in keeping with the general spirit of the *L'Escola de Baasneere* project and aims to contribute to the construction of a building adapted to its surroundings in material and architectural terms, as well as socially and economically. Schools in the country, often the result of cooperation projects, are built with cement blocks, corrugated sheet metal and other industrial materials. The spaces created using these materials are often overheated in the Burkinabe climate. This leads to insalubrious conditions so that pupils are forced to vacate the building and attend class outdoors under the shade of a tree. The design for *L'Escola de Baasneere* is a clear improvement over these

Students of Baasneere school observing the development of the organized workshop.

conventional schools, paying special attention to location, to the distribution of modules and to the constructive techniques used. With this main objective in mind, the cooperation project follows three approaches:

1. To offer scientific-technical support for the design and construction of a sustainable project in environmental, sociocultural, and socioeconomic terms.
2. To contribute to the technical training of young people in Baasneere, to facilitate their hiring during the construction of the school and to encourage their professional development.
3. To involve the local population in the construction process for the school so that they can feel it as their own, and it can be assimilated more thoroughly by the community.



Proposals for the design of L'Escola de Baasneeré developed by architecture students during the design workshop.

On a practical level, these three scales are reflected in different lines of work:

- Researching the potential of CEB tile vaults and their applicability in the school project.

- Raising awareness of CEBs and tile vaults among the inhabitants of Baasneere. The aim is for them to feel that these materials are their own, a technical evolution of their traditional architecture which allows them to improve their buildings without having to compromise on the use of local and sustainable materials suited to the region's climate conditions.

- Developing the capacity for production and the generation of resources of the inhabitants of Baasneere. The local economy is currently based on agriculture and subsistence

Sustainable Development Goals for the 2030 Agenda for Sustainable Development (Source: United Nations).

livestock farming, and there is barely any economic activity. This hinders the education and human and professional development of local young people.

The design of the project and the objectives set are within the framework of the United Nations 2030 Agenda for Sustainable Development[133].

This project has specifically attempted to develop the following Sustainable Development Goals:

Goal 4: To ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

[133] General Assembly of the United Nations. Resolution A/RES/70/1: Transforming our world: the 2030 Agenda for Sustainable Development. New York: United Nations Organization, 2015.

Manufacturing adobe during an earthen construction course held at the UPV.

Goal 8: To promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.

Goal 9: To build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.

Goal 11: To make cities and human settlements inclusive, safe, resilient, and sustainable.

Work methodology

The objectives and lines of work of the project have been divided into six phases carried out in the Universitat Politècnica de València campus and in the village of Baasneere over a two-year period.

A conventional school built with concrete blocks and sheet metal. Baasneere, Burkina Faso.

Phase 1: Study of the local situation

Since 2009 Algemesí Solidari has been working permanently in Baasneere, collaborating closely with the local community and the Burkinabe association A3B. Thanks to this and the participatory processes carried out in the early stages of its projects, the NGO has a full clear picture of the local situation.

The project began with a process of analysis of the context which covered the study of the population (characteristics, customs, values, etc.), of the traditional architecture of the region, and other projects for the construction of schools in similar areas. It also examined the potential of the surroundings both in material terms (materials available, common construction techniques, etc.) and human terms (presence of construction companies in the area, existing and necessary training, etc.).

Phase 2: Scientific research and experiments at the UPV

Once the context had been studied, research was carried out exclusively on the Universitat Politècnica de València campus. This work

Classroom building for the secondary school developed by Algemesí Solidari.

consisted of the analysis of samples of constructive materials from Baasneere and the study of their feasibility to produce CEBs and bonding mortars for the vaults.

Experiments in this phase made it possible to ascertain a suitable size and composition for CEBs, seeking to balance resistance, lightness, and sustainable production. Different dosages were also studied for the bonding mortars to identify a fast-setting formula which would allow the construction of vaults without centring.

Experiments with earthen mortars on the UPV campus.

Work meeting for the organization of the workshops.

Phase 3: Design of training and participation activities

The fieldwork for Burkina Faso and the different activities to be developed have been organized based on the results of the research and experimentation phase:

- Training of NGO workers from the Algemesí Solidari association.
- Technical training activities for workers from different companies in the construction sector in Ouagadougou.
- Technical training activities for young people and builders from Baasneere.
- Awareness and participation activities aimed at the population and children of Baasneere.

Participants in the construction workshop in Baasneere.

Phase 4: Professional training and technical empowerment of the local population

The tasks for professional training were organized around two workshops. The first of these was carried out in the country's capital, Ouagadougou, and involved workers from different building companies, workers from a company which manufactures CEBs, and several architects and civil engineers. The second workshop was held in Baasneere and involved local builders and young people likely to be hired as apprentice builders during the construction work on the school.

Both activities followed a learning by doing methodology, based on a learning process which inverts the conventional pedagogic model. Specific practical activities are completed to extract the rules which made it possible while theoretical knowledge is acquired inductively.

Participants in the construction workshop in Ouagadougou.

Following this process for the progressive extraction of knowledge, workshops were divided into three parts. A brief initial introduction to the vaults and the specific technique to be used was carried out. This was followed by a practical construction exercise which included the production of the necessary auxiliary means and their use in the construction of a vault. Finally, a short theoretical module was presented, showing real cases to illustrate the possibilities of this technique, followed by a practical design activity to make use of this potential.

Phase 5: Social participation activities

The work for raising awareness among the local community mostly took the form of a children's workshop carried out with pupils from one of the

Children's workshop on traditional architecture.

Children taking part in the traditional architecture workshop.

local primary schools. This workshop aimed to foster valorization and appreciation felt by young people for their traditional architecture and the techniques used to construct the secondary school which they will be attending in the future.

The children's workshop was divided into two parts. The first session focused on the characteristics of the earth, the predominant material in traditional Mossi architecture. This block included a simple examination of topics such as the variety of colours and textures found in the earth, the different elements that make it up, and how it changes its consistency depending on the moisture content. The second session focused on the use of this material in vernacular architecture. This module included a brief explanation of the various types of traditional earthen dwellings found in different parts of the world. The aim of this was to show the boys and girls how in all these places traditional architecture makes use of its natural materials and is built in a way that is suited to its climate.

These activities aimed to explain to the boys and girls, simply and through play, why the buildings in their village were traditionally built with earth and how this material can be used in construction. These activities aimed to promote the appreciation of local culture and architecture among children so that in the future they may be more inclined to preserve their own identity despite changes brought about by industry, globalization, and speculation.

Joint presentation with Algemesí Solidari at the Casino de Algemesí.

Phase 6: Dissemination of results

The final phase of the project focused on the dissemination of results and increasing awareness in our society, aiming to promote interculturality and to generate cycles of empathy, tolerance and solidarity. This dissemination work was carried out through different channels such as the creation of a website for the project, the publication of several scientific articles, educational talks and the organization of an exhibition at the UPV School of Architecture and the Casino Liberal in Algemesí.

Detail of an earthen tile vault.

17. Earthen tile vaults: Geometric optimization and structural behaviour

Compressed earth blocks, also known as CEBs, are small modular elements used in the construction of architectural elements made of masonry. These are produced by using a press to compact a damp earthen mass which is usually dosed with a small proportion of cement, between 5% and 8% in most cases,[134] although other stabilizing materials such as lime,[135] fly ash or plant waste[136] can also be used. The execution system for Compressed Earth Blocks or CEBs is like that of brick, light enough for a single worker to handle with ease.

[134] AMACO. Atelier BTC. Fiches Techniques. Grenoble: CraTerre ENSAG, 2015.

[135] Nagaraj, H. B., et al. "Role of lime with cement in long-term strength of Compressed Stabilized Earth Blocks." *International Journal of Sustainable Built Environment* 3.1 (2014): 54-61.

[136] Villamizar, María Catalina Niño, et al. "Effect of the addition of coal-ash and cassava peels on the engineering properties of compressed earth blocks." *Construction and Building Materials* 36 (2012): 276-286.

The most common block format is 29x14x9 cm, weighing 7-8 kg, depending on the degree of compactness and the type of earth used. In terms of mechanical properties, this is one of the earthen constructive systems with the highest resistance to compression. While Spanish regulation UNE 41410 establishes three resistant types with normalized values of 1.3, 3 and 5 MPa,[137] it is not uncommon for pieces to exceed stress values of 7 MPa.

As compacting causes a considerable reduction in porosity, and these pieces are stabilized using small amounts of bonding agent, compressed earth blocks are more resistant to humidity than most earthen construction systems.

[137] AENOR. UNE 41410. *Bloques de tierra comprimida para muros y tabiques. Definiciones, especificaciones y métodos de ensayo*. Madrid: Asociación Española de Normalización y Certificación, 2008.

Stored CEB blocks.

Construction of a CEB enclosure in Ouagadougou, Burkina Faso.

Besides, this technique is suited to a wide range of granulometries, which makes it more likely to find suitable soil near the intervention.

As these pieces are easy to produce and can be obtained on-site using very small manual presses, this is an optimal system for construction in hard-to-access areas or non-industrialized locations.

The manufacturing of CEBs does not require fuel, and their adaptability to materials available in the immediate surroundings allows energy consumption due to transport to be minimised. These materials have therefore got a shallow thermal footprint and, thanks to their high density and thermal inertia, can provide insulated, breathable environments with a high level of hygrothermal comfort.[138]

CEBs are solid constructive elements of great interest, especially in areas with medium to extensive building, where the construction of very tall buildings does not necessarily require the use of metal or reinforced concrete structures. It is also an ideal technique for the construction of buildings with very little industrialization, as it requires little technical means other than simple

[138] Barbeta, Gabi, and Esteve Navarrete. "A pentagonal block home." *Earthen Architecture. Past, present and future: proceedings of the International Conference on Vernacular Heritage, Sustainability and Earthen Architecture*, 31-36. London: Taylor & Francis Group, 2015.

manufacturing and execution, affordable to local workers without specialist training. Therefore, executing complete building systems using CEBs as major elements would make it possible to construct economic, sustainable, comfortable, and technically feasible buildings, even in areas with limited resources.

Given the limited resistance to bending of the construction elements, the most natural way to build horizontal structures using CEBs is the execution of vaults. However, in themselves the blocks of compressed earth are hard to lighten due to the compacting process. As a result, the use of pieces in their usual format results in heavy rowlock vaults which require major centring for their construction. This additional cost becomes a major conditioning factor in arid settings where development cooperation projects are often being carried out. In fact, at present, CEBs are the most commonly used element in this context, and cost can hamper the feasibility of a system which is otherwise appropriate in all other aspects.

Adapting these pieces for use in the construction of thin shells makes it possible to reinforce this system at its weakest point, opening up a wide range of possibilities for the development of an economic sustainable technique which could be easily extrapolated to isolated settings with little industrialization.

Optimization of funicular design

The possibility of using CEBs for the construction of lowered or surbased barrel vaults was firstly approached in mechanical terms through a study aiming to assess the potential for covering spaces of usual dimensions in residential architecture using surbased vaults built with CEBs.

Vaulted systems work in compression alone, which allows them to be built with masonry elements, and they usually display very low tension. Thus, the resistance of the materials which compose them is not critical to the stability of the vaults. However, supports lead to a series of horizontal thrusts on the ends of the supporting elements and can cause major bending stress. This horizontal thrust can be limited in the design of the vault – reducing its weight or raising its outline – or can be absorbed by the elements which incorporate it.

As calculations consider specific materials, in this case the thrust of the vaults could only be reduced by modifying thickness and span-to-rise ratio. However, the resistance displayed by these systems due to their shape means that more precise outline is required in a smaller section to prevent the appearance of tensile stress in the construction. Equally, incorporating a higher section results in a steeper slope and the horizontal component of the thrust is reduced. This heightening of the roofs, using more vertical space, increases the cost of the work. Based on this, 120 vault models were analysed in total. These provided a wide range of alternatives based on the combination of three variables: span, span-to-rise ratio of the funicular arch described in their outline, and the thickness of the resistant layer.

In this way, work was done with vaults that bridged the usual distances in residential architecture, and which were traced following

Manual block machine for the production of CEBs. Universitat Politècnica de València.

surbased catenaries and applying different span-to-rise ratios (3%, 5%, 7%, 10%, and 15%). The alternatives displayed 5 different proportions between horizontal thrust transmission and vertical space used. Each of these traceries considered three different thicknesses (9, 14, and 19 cm) and the possibility of using small partition

CEBs produced in the Universitat Politècnica de València.

walls – positioned on the vault to generate a flat roof which could be accessed – to act as collaborating CEB ribs or as elements with no structural role.

The stability of each individual model was analysed using 2D graphic statics, assessing actions common in residential use. In all cases, calculations showed that the thickness and outline of the vault could withstand the line of pressure caused by the dissipation of loads and that the sections were stable without needing to use collaborating ribs. It was therefore determined that the lowest thickness considered would suffice to cover this type of vault.

Production of CEBs as part of the WithBurkina project in the Universitat Politècnica de València.

Since all the designs were found to be stable, it was established that the optimal section would be the one with the most balanced ratio between the width of the resulting floor and the size of the elements needed to withstand the thrust.

The horizontal thrust of a vault can be absorbed by introducing reinforcements into the wall, allowing it to work under flexo-compression, or through elements placed to absorb the horizontal component, such as buttresses, tie beams or piers. A large amount of steel is necessary to reinforce brick walls, something which is at odds with the premise of this study. Furthermore, the introduction of buttresses leads to a major increase in material and space used. In contrast, the tie beams and piers act directly on the point of contact between the vault and the

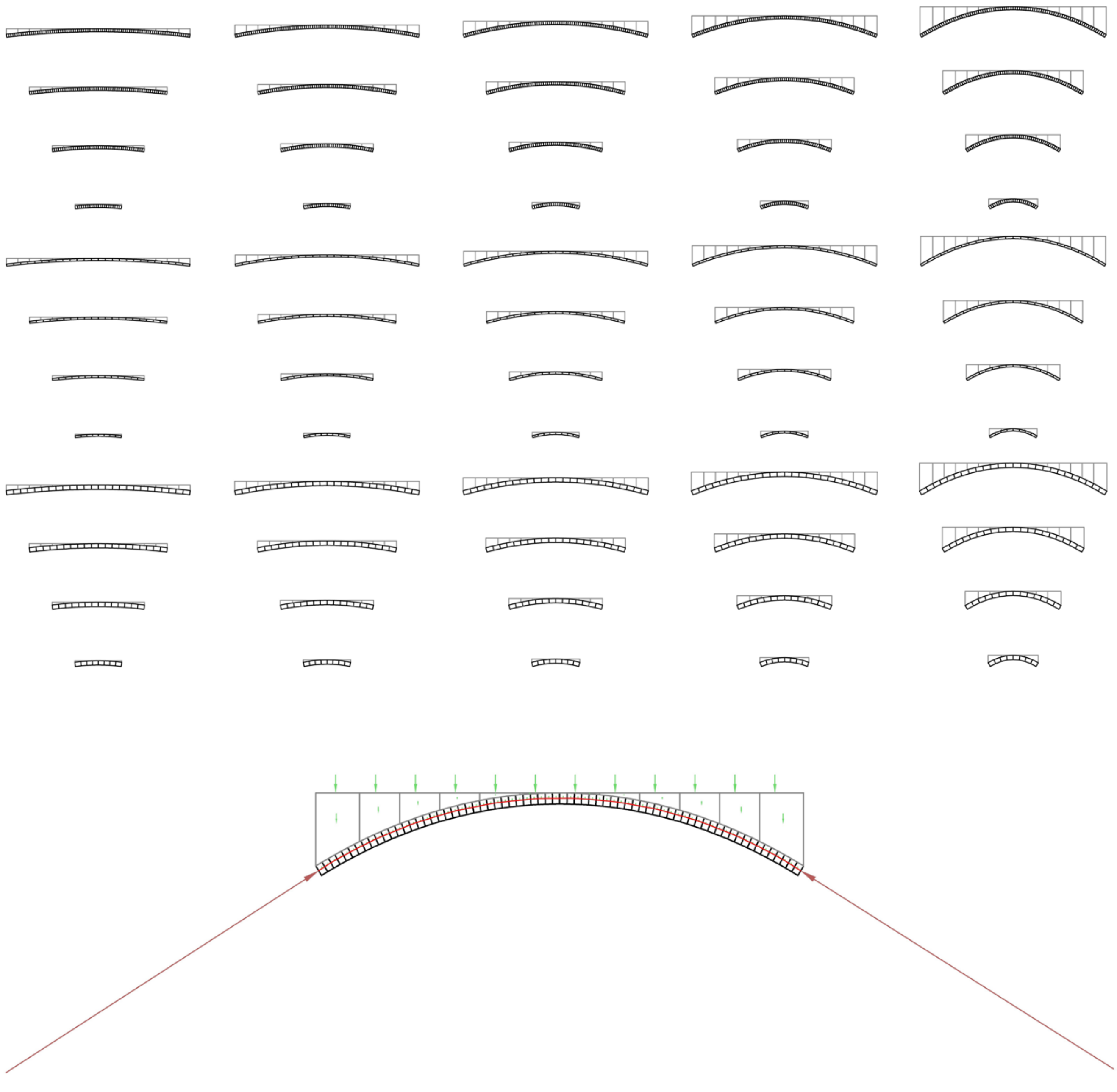
Opera Village by Francis Keré, built with CEBs in Laongo, Burkina Faso.

Opera Village by Francis Keré, built with CEBs in Laongo, Burkina Faso.

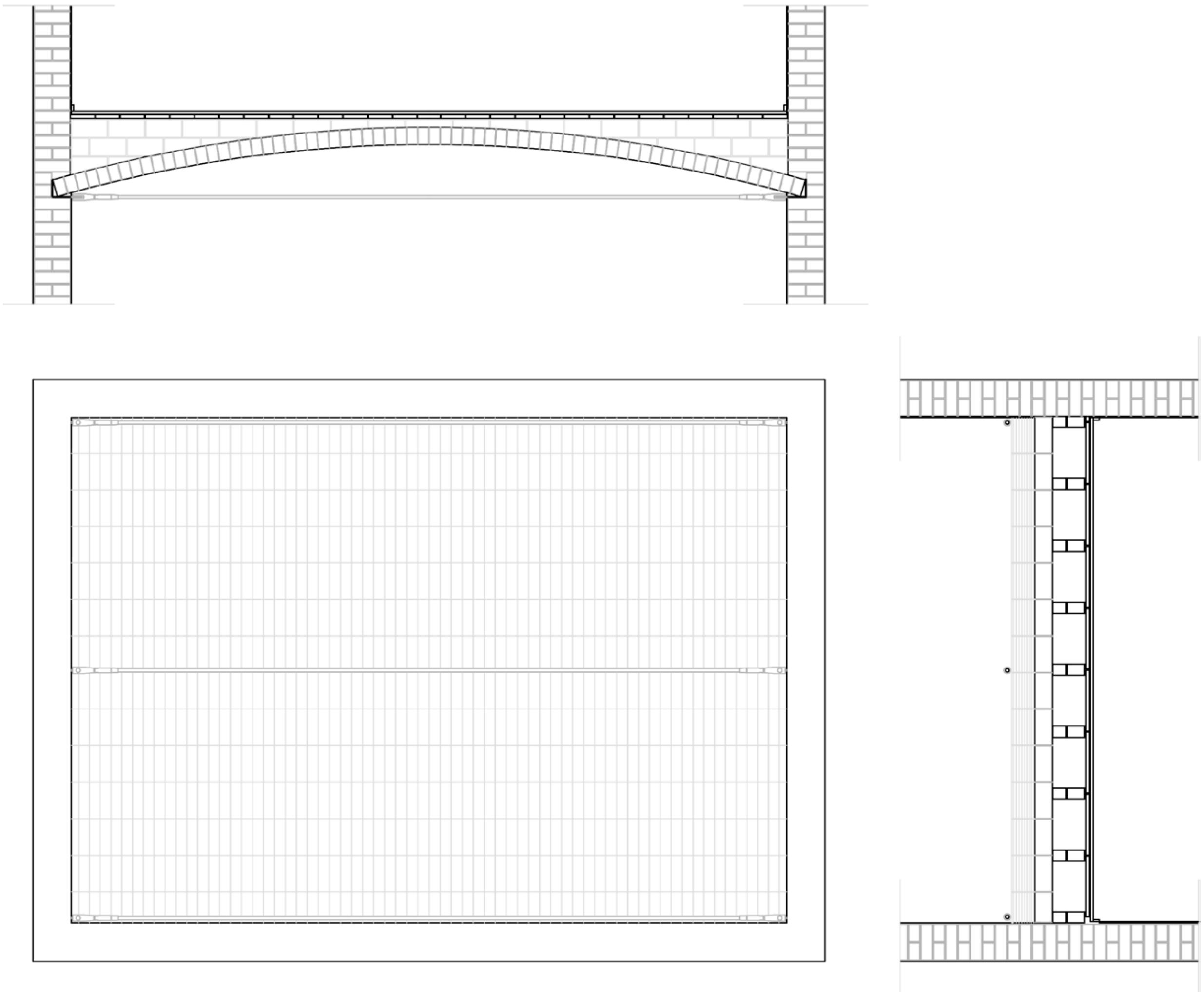
Construction of a CEB tile vault prototype in the Universitat Politècnica de València.

wall, absorbing the thrust before it is transmitted to the support, and thus requiring less material. These elements are external to the vault solution and were designed in metal in order to speed up calculations. The solution proposed consisted of two angles incorporated into the wall and into the vault supports, and tie beams placed two metres apart to absorb the horizontal thrust.

From the data obtained in the study, it was established that the supporting wall tiles were not needed to guarantee the stability of the vault. However, they did not result in any substantial modification to the stress state of the constructions compared to the lighter elements, and their use in the floor could be justified on the grounds of material and socioeconomic coherence. Finally, it was concluded that the



Vault models with different impost height, span, and bonding for the analysis and balance analysis of a rowlock CEB vault, leaving a 6 m opening with a span-to-rise ratio of 15%.



Typical constructive detail for the calculated solution. CEB vault, formation of the flat accessible roof, tie beam system, and point of contact with the wall.

design with 10% span-to-rise ratio were the alternatives which best combined the lightness of the elements for the reduction of thrust with the reduction of the edge of the roof. Therefore, it was established that depending on the characteristics of each individual project, the reasonable values for span-to-rise ratio ranged between 7% and 15%.

Drawing a catenary profile on a board for use to guide the construction of a tile vault.

18. Earthen tile vaults: Experimentation and constructive process

In its immediate application, the cooperation project has put into practice the experiences developed by the Res-Arquitectura group during the 2016 Venice Biennale, where experiments were carried out using compressed earth blocks and gypsum to build tile vaults. However, this project also included research aiming to design advances in the construction of tile vaults without having to use industrialized materials but including the use of earth for mortars.

Prior experiences

The initial experiences in building CEB tile vaults were carried out by the Res-Arquitectura group in 2015, in collaboration with the Massachusetts Institute of Technology, as part of its *Beyond Bending* pavilion for the 2016 Venice Architecture Biennale. This involved the design and construction of two small tile barrel vaults, executed with CEBs.

These elements were designed for 1.40x2.00 m and were outlined following a catenary curve with a 10% span-to-rise ratio on the larger side. It was established they should be built with two layers, selecting a total thickness of 7 cm. The first layer was set with fast-setting gypsum and the second with an earthen mix mortar.

The blocks used in this case were supplied by a commercial company, meeting the demands of UNE 41410.[139] The format of the pieces was determined in the project and was set at 200×95×33 mm, creating tiles with characteristics that are more suitable for the construction of tile vaults than the ones with the standard format units.

[139] AENOR. UNE 41410. *Bloques de tierra comprimida para muros y tabiques. Definiciones, especificaciones y métodos de ensayo*. Madrid: Asociación Española de Normalización y Certificación, 2008.

The earth used to produce these blocks had a high sand content (approximately 65% of its weight distributed in particles between 2 and 0.5 mm) and about 12% silts and clay. After being stabilized with 5% lime and 2% cement, this soil was compressed to produce pieces with an approximate density of 2,140 kg/m^3. The compressive resistance of these pieces was assessed through direct compression tests following the procedure detailed in UNE-EN 772-1:2002.[140] In this type of test, the growing compressive stress causes the test specimens' progressive side deformation continuing to their shear point. This deformation is distorted by the friction between the sample and test plates so that the apparent resistance of the material increases as the distance between the plates decreases.[141] To counter this effect, Table A.1 of UNE-EN 772-1:2002 establishes a form factor d, which reduces the resistance obtained. The four tests, carried out on 3-year-old samples with a speed of 0.3 MPa/s, showed a corrected resistance of 8.68 kN.

Construction of vaults

The replacement of ceramic pieces for compressed earth tiles brought about a need for some adjustments in the traditional constructive process. The lightness of the ceramic tiles and the gypsum's setting speed allow traditional tile vaults to be built without centring when there is at least one sidewall to which the first pieces can be attached. However, when these are made as standalone systems, a small guide, a board set plumb, or a provisional supporting wall are used to support the initial construction of a brick arch. Once this first arch is finished, subsequent pieces can be added without a need for centring.

However, the compressed earth tiles were heavier than the ceramic tiles – the pieces used in this case weighed around 1.5 kg – and the gypsum needed to set for approximately thirty seconds before becoming self-supporting. For this reason, it was decided that the initial guide would be used to support every arch that was under construction.

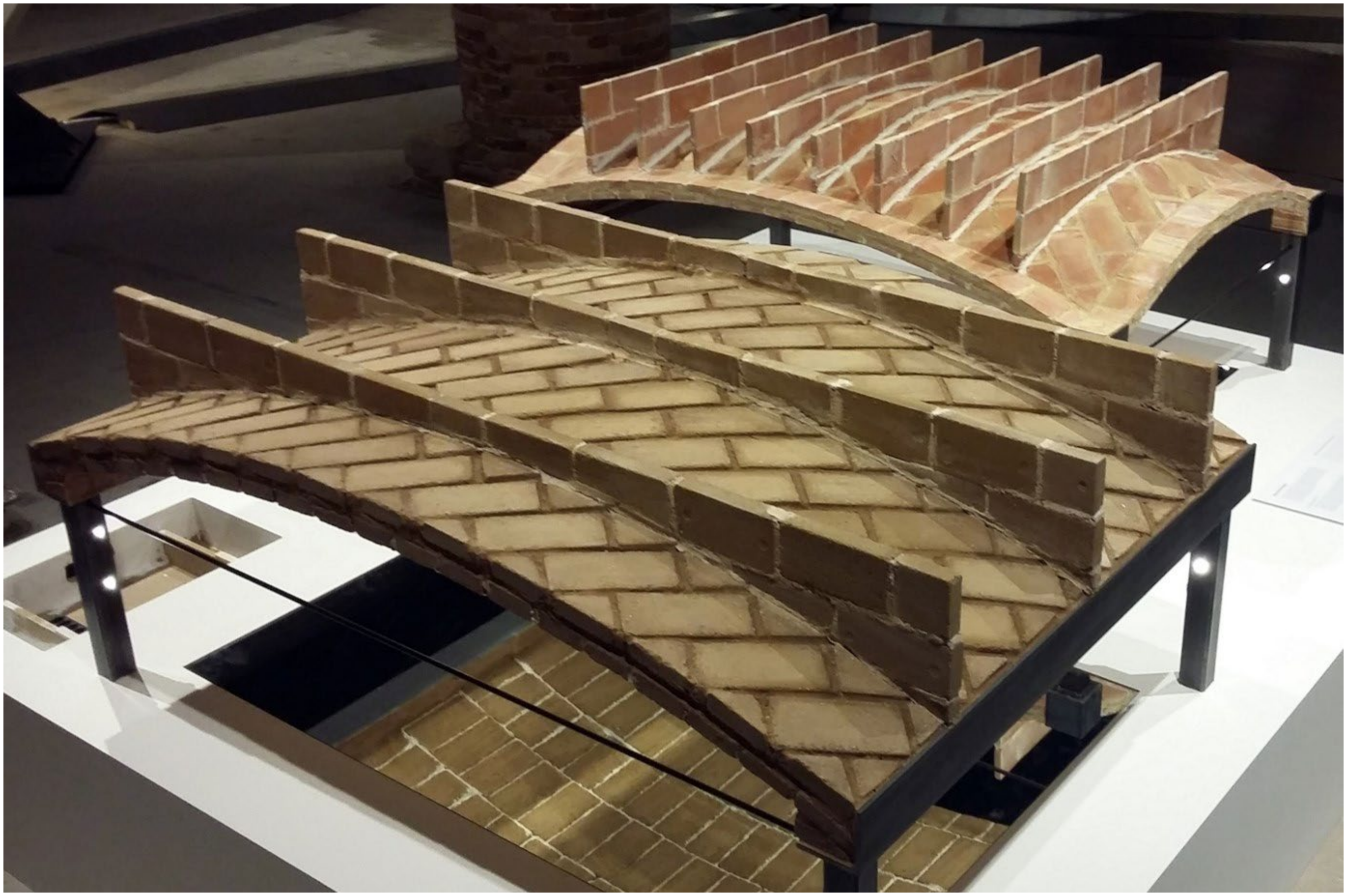
Once the arch was complete, the guide was immediately moved along to build the following one. Once the first leaf was finished, the second could be executed directly on top. This double layer increased the resistant section of the element while providing mechanical continuity. It thus acted as a structural shell instead of functioning as a series of arches.

Based on this initial experience, it was observed that the thickness of the CEBs could be reduced to form tiles without increasing the bonding agent content. Thanks to this, the vault thickness can be adjusted better to the structural calculation's needs, reducing the material consumed, the weight of the element itself, and the horizontal thrust it generates. Thus, the use of tiles approximately 3 cm thick makes it possible to build CEB tile vaults.

140 AENOR. UNE 772-1. *Métodos de ensayo de piezas para fábrica de albañilería. Parte 1: Determinación de la resistencia a compresión*. Madrid: Asociación Española de Normalización y Certificación, 2002.

141 Morel, Jean-Claude, Abalo Pkla, and Peter Walker. "Compressive strength testing of compressed earth blocks." *Construction and Building materials* 21.2 (2007): 303-309.

Two prototypes of earthen tile vault.

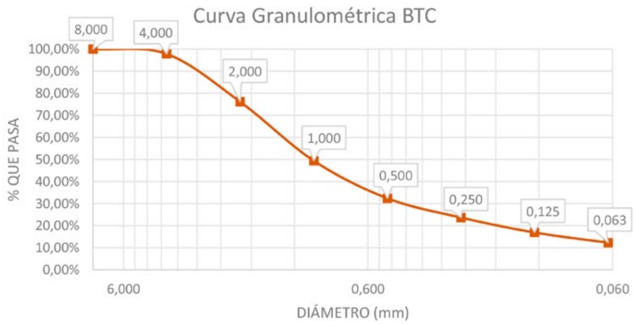


CEB vault shown in the 2016 Venice Architecture Biennale in the Beyond Bending Pavilion, directed by BRG and ODB Engineering.

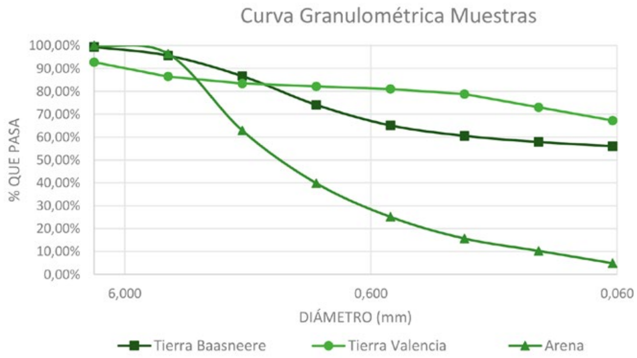
As the CEBs are heavier than ceramic bricks, these systems are not as self-supporting during their construction as traditional tile vaults. However, they do not require centring and can considerably reduce investment in auxiliary means compared to CEB rowlock vaults. The use of tiles and a lightweight guide allows easier handling of the elements, speeding up production.

Tile vaults with earth mortar

During the research undertaken as part of the project, work was carried out using tile barrel vaults with a 1.40 m span and a 66 cm rise. These measurements had been established based on architectural criteria during the design of the school. The compressed earth tiles used



Results of the CEB sieve analysis.



Results of the sieve analysis of the samples of soil and sand: earth from Baasneere; earth used in the tests carried out at UPV; and sand used to correct the earth samples in Valencia.

were similar in origin and size to those used for the Venice Biennale. The earth and cement used to manufacture mortar were selected for their similarity to the materials available in Baasneere. This required the analysis of a series of earth samples collected in Baasneere by members of the association and the identification of similar materials available in Valencia.

Sifting earth samples to determine granulometry.

Study of mortars

The use of mud mortar with a high clay content was proposed to build the first layer of the earthen tile vaults. The aim of this was to ensure a high initial adherence to minimize the need for centring. However, the second layer was built using earth-cement mortar to provide greater resistance for the vault in the medium and long term.

The granulometric tests carried out on soil samples from Baasneere showed a high proportion of silts and clay (approximately 56% in the mix) and a relatively high proportion of coarse sand, with 21% in mass in particles from 2 to 0.5 mm. This prompted the decision to work with a very clayey material, which, if necessary, could be corrected with sand to obtain a granulometry like the local one. After analysing soil from different sources, earth with a silt and clay content of approximately 67% was chosen from an excavation in the town of

Complete CEB tile vault and tests for the construction of small wall partitions to support the paving.

Complete CEB tile vault and tests for the construction of small wall partitions to support the paving.

Alacuás (Valencia). CEM II/B–M (S-L)/42.5R cement was used in a mixed mortar dosage. Coarse sand with approximately 71% of its mass in 0.5 – 4 mm particles was used for occasional corrections in the mix.

The exact dosage of the earth mortar was established through a fissure control test based on that established in Annex 4 of the Peruvian standard on earthen construction E-80.[142] For this, different earth mortars (with increasing quantities of sand) were prepared and used to bind three pairs of CEBs in each case. The three specimens for the individual mixes were separated after 6, 24, and 48 hours to examine the cracks in the mortar.

This test was carried out initially by joining the pieces along the bed, as stipulated in E-80. However, the earth mortar selected had to be used to bind the pieces of the lower leaf of the vault, which are joined by the edges. This led to further testing of the dosages, which had provided the best results, this time binding the edges. This test aimed to increase the proportion of mortar that dried in direct contact with air through the join and to identify any potential changes in the result.

In the first observation, the best results were obtained when using a mortar with a 3:1 ratio of earth and sand. However, as exposure to air increased in the second test, the mortar dried too fast, causing adherence problems, so that it was decided to work directly with an uncorrected earth mortar. In this case, the high concentration of clay ensured the join remained

[142] MVCS. *Norma E.80 Diseño y construcción con tierra reforzada*. Lima: Ministerio de Vivienda, Construcción y Saneamiento, 2017

Adherence tests were carried out with different mortar dosages to determine the ideal ratios for the construction of the vault.

damp longer and provided it with fair adherence in the time needed for the upper leaves to acquire resistance.

To establish the exact proportion between earth and cement, the test procedure described in Norm E.80 was followed. On this occasion, different ratios of soil and cement were tested. The dosage with the least cement and no visible cracks after 48 hours was chosen in this case. This mix was then tested a second time, adding different proportions of coarse sand. Finally, the decision was made to use a mortar with a 3:1 ratio of earth and cement, which was not corrected with coarse sand.

Construction of vaults

After selecting the mortar dosages, the feasibility of the technique was tested with the construction of a series of vaults, first with a 90 cm span and a 70 cm rise and later in the measurements stated in the project. The starting point for constructing these prototypes was the system tested with the construction of gypsum-set CEB tile vaults. However, this change of material once again required the constructive process to be readjusted.

As earth mortar does not set as quickly as gypsum, it was decided that a second guide should be introduced during the construction of the inner leaf of the vault. The first of these guides was used to execute the first arch. Once completed, the second guide was added to build a second arch beside it.

This meant that the first guide was not required again until the construction of the third arch, leaving sufficient time for the mortar of the first element to harden and become resistant, with the second arch, which still had its centring, also providing lateral support. The lower layer's construction can be prolonged, alternating only two guides to reach the necessary length. The second layer, set with earth and cement mortar, is built directly over the lower one and provides structural continuity while increasing medium- and long-term resistance.

Results

The use of earth with high clay content in the lower layer of the vault has improved the behaviour of the mortar compared to the tests carried out in mixes with a higher sand range. When testing the dosage of these mortars, it was observed that the amount of material that dries in direct contact with air through the join greatly improves its capacity for adherence. Therefore,

Prototype of CEB tile vault with earthen mortar.

the usual study of dosage based on joined pieces alone is not enough but requires complementary adherence tests on pieces joined on the edge.

The results obtained to date are promising but are yet to be completed with load and aging tests. After two years of exposure to weather conditions, the initial prototypes are stable and display no significant degradation signs. However, the results of this research can only be considered preliminary, and further research is necessary, including load and aging tests. In any case, this experience opens interesting paths of study for perfecting techniques, including the possibility of using earth mortar with natural fibres or producing lighter CEB tiles.

Comparison of the auxiliary means needed to cover the school using rowlock (above) or tile vaults (below).

Image of the workshop on vaults carried out with the residents of Baasneere.

19. Construction workshops for the professional training and technical empowerment of the community

Economic interests, tourism, international cooperation, and the representation of Western society in the media result in cultural interferences which cannot be avoided in developing countries. This influence often leads to the creation – through imitation – of new paradigms associated with the image of success and wealth. In settings with limited resources, the alteration of social prestige models leads to the rejection of traditional ways of life, and assimilation has imported and reinterpreted canons which impoverish the local culture and worsen the quality of life.

In the case of housing, this influence usually takes material form in the abandonment of vernacular typologies to be replaced with lower quality housing built using cement and corrugated iron, insalubrious materials which harm the surrounding environment and landscape. These transformation dynamics, while inevitable and irreversible, can be redirected to improve the quality of life in communities, limiting this cultural impoverishment.

In this process, training and raising awareness among the local population are essential, and the role of NGOs can be extremely important. These associations work directly with the parties involved and the result of their projects is often the construction of remarkable buildings which become architectural models in the communities. For this reason, the development of a responsible sustainable architecture for cooperation and increasing awareness and the technical empowerment of the local population are essential tools in guiding this change of paradigm.

A series of training actions for construction have been carried out in the framework of this cooperation project, involving both professionals

Design of the vault profile using a catenary curve.

Construction of the wooden centring.

in the sector and local young people. The aim of these activities is two-fold, as they have trained the workers needed for the construction of the vaults for the school, while allowing society to embrace a technique which can offer points of reference other than cement and corrugated iron, promoting the development of a healthier, more sustainable architecture.

Objectives and scope

These training workshops have had different technical and social objectives. The immediate technical aim has been to offer Algemesí Solidari access to professionals skilled in the construction of school vaults. Another medium-term objective has been to try and bring about the technical assimilation of the constructive system, so that it may be used following the completion of the project. These activities have therefore included workers from the development company in charge of the school as well as other professionals in the sector and local young people.

Two workshops were carried out in Ouagadougou and Baasneere to train 35 individuals from highly varied backgrounds: architects; civil engineering students; builders (self-employed or working for developers); CEB manufacturers; and untrained young people.

The involvement of all those taking part in the process (producers, developers, specialists, and receiving community) aimed to generate a complete chain to assess this technique, which could be used once the school was completed. The attendance of technical specialists was appealing to developers, who were interested in this technique which they saw as a potential source of work.

Construction of the inner layer of the vault.

At the same time, the participation of builders working for different developers favoured the transmission of knowledge, encouraging participants to learn in order to be able to offer the same or better services than their rivals in the future.

A finished vault in the Ouagadougou workshop.

In social terms, attempts have been made to contribute to assimilation of the school project and to technical empowerment among the population of Baasneere. Training local young people has provided a rare professional

One of the work teams at the Ouagadougou workshop.

opportunity in a setting with no economic activity. This experience could lead to young people accessing the work market during the construction of the school, giving them the chance to learn a trade, and to broaden their horizons both professionally and personally. In addition, it was hoped that participation in the school project would lead to this community viewing the building as its own.

Holding this workshop in the community aimed to spark interest among the local population, following frequent visits from the local chief, the committee, and the teenagers studying in the classroom which had already been built. It is hoped that this, and the conviction that they are contributing to the construction of the school, will encourage the residents of Baasneere to embrace this technique.

Students from the secondary school taking part in the workshop in Baasneere.

Structure and development

Most of the students taking part in the construction workshop come from a traditional background, used to repeating conventional processes but unaccustomed to abstraction and creative work. As a result, the activities have been organized following an inductive process and *learning by doing*[143] methodology, which uses a specific example as a starting point before extracting the rules sand theory of the technique through generalization.

[143] Rama, Dasaratha V. *Learning by Doing: Concepts and Models for Service-Learning in Accounting*. Washington, D.C.: American Association for Higher Education, 1998.

Vault construction workshop in the village of Baasneere.

Development of the workshop in Baasneere.

The activities have been structured following an inductive logic answering the questions: What are we going to do? How is it done? How much effort does it require? What possibilities does it offer? How can I take advantage of these possibilities? Based on this process for the progressive abstraction of knowledge, the workshops have been organized into three sessions: a brief introduction on the constructive system, a practical construction exercise, and a module on the potential of the system learnt.

Introductory session

The workshops began with an introductory session in which the course programme was described and the construction system to be learnt and its usefulness were briefly explained. This introduction was supported by photographs of real cases of use of the technique to facilitate understanding.

The professional training workshop for young people from Baasneere was held in a space beside some classrooms built in an initial phase of the school design. This pavilion has been a good teaching aid for the introductory session as students were able to examine the vaults (built using a different technique) and compare them with the examples previously provided in order to encourage discussion.

Execution of the second layer.

A finished vault in the Baasneere workshop.

Session on the design and construction of tile vaults

This session was divided into two different activities: a workshop on the design and construction of centring and another on the construction of vaults themselves. In order to make the activity dynamic and effective, students were divided into groups of seven and worked separately on the construction of a vault.

The aim of the first workshop was for students to learn a simple system for the design of centring on the construction site, understanding the importance of a correct outline in ensuring stable vaults and checking whether they were able to produce all the auxiliary means needed for vault construction.

The second workshop consisted in the construction of a tile vault with CEBs using the centring built in the previous activity. This task allowed students to put this constructive technique into practice, learning basic execution concepts such as the importance of ensuring vaults are firmly supported or avoiding continuous joins.

Moreover, this task also introduced them to the use of gypsum as a constructive material for producing the mortar for the pieces. This session ended with a joint discussion from which the main lessons learnt were extracted while the main aspects to be considered were highlighted.

Construction of the frame, putting the fabric in place and soaking it in gypsum.

Drying of the model.

Session on the design of vaulted spaces

Once students understood the usefulness of tile vaults and applied the constructive system a third session for exploring the architectural and expressive potential of this technique was held. The aim of this workshop was to prompt an assessment of constructions with tile vaults where these were seen positively as comfortable, useful, and beautiful buildings. This activity was included in the Baasneere professional training workshop solely to encourage feelings of appreciation and attachment towards the school building.

This session was divided into two parts. An initial theoretical activity was carried out using audiovisual resources and explaining a series of buildings with tile vaulting, using the formal and expressive qualities on offer from these systems to their full potential.

Finished funicular model.

Students were then divided into two groups, in charge of designing a building based on funicular models.[144] These models are based on the

[144] Songel González, Juan María. "Form follows forces. Building funicular models to show how gravity shapes form", in *7th*

Results of the workshop in Baasneere.

capacity of gypsum-soaked fabric to hang down and generate concave shapes. When the gypsum in which the fabric is soaked hardens, the models can be turned over transforming these shapes created by gravity into vaults, arches, and domes.

At the start of the activity the groups were supplied with fabric, reeds, and string. They had to use these materials to build a frame, placing the fabric so that it formed an inverted figure of the desired space when hanging. Once the model was complete, soaked in gypsum and left to dry, students discussed the way in which the vaults worked.

This activity provided students with a more abstract understanding of the technique and even allowed them to work on aspects relating to the design of the spaces, showcasing the possibilities of the new technology acquired in other buildings such as their own dwellings.

International Conference on Education and New Learning Technologies (EDULEARN 2015), 621 – 626. Barcelona: IATED, 2015.

Workshop raising awareness on earthen architecture for the children of Baasneere primary school.

20. Awareness workshops

Raising awareness: Concept and methods in the framework of heritage education

Making a collective realize the importance or value of a given subject/object is perhaps the most appropriate way to transmit this concept within the pedagogic dynamic of actions linked to heritage education. Although great advances have been made in heritage education in Spain, it is still considered to be an emerging field, independent from others such as cultural history, history of art, or social sciences.

This growth is also evidenced by the creation of the Observatory of Heritage Education in Spain[145] which is in charge of organizing, analysing, systematically cataloguing, and disseminating the actions completed in the field. This observatory aims to establish a basic national heritage education model closely linked to the principles of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Council of Museums (ICOM), global points of reference on heritage and its introduction through education.

As part of its work the Observatory has analysed the most representative discourses in heritage education in Spain[146] and has found them to revolve around four different stakeholders, with teacher, student, context, and content as central elements. Some actions involve the intersection of two or more proposals (focusing for example on the student and teacher, on the combination of content and context, or on all four actions simultaneously). Some projects adapt to the interests and needs of the target, while others consider the knowledge of receivers to ensure significant learning and to help them identify with heritage.

[145] Observatorio de Educación Patrimonial en España. http://www.oepe.es/. Salazar Castañeda, Mitzi Violeta. "La educación patrimonial en España: Objetivos, Principios y Experiencias". *Correo del Maestro: Revista para profesores de Educación Básica, 226* (2015). https://www.correodelmaestro.com/publico/html5032015/capitulo5/La_educacion_patrimonial.html

[146] Fontal Merillas, Olaia. "Educación patrimonial: retrospectiva y prospectivas para la próxima década." *Estudios pedagógicos* (Valdivia) 42.2 (2016): 415-436.

One of the models built during the workshop.

Finally, others are more concerned with the sustainable development of the regions where they are applied. Despite these differences, all these models for heritage education programmes display a general concern for valuing heritage assets, in their broadest sense, as the central content to be developed in educational activities. Thus, the interpretation of heritage is another central aspect of heritage education.[147] This interpretation translates the meanings and

[147] Marín Cepeda, Sofía. "Una educación patrimonial para todos, a través de la tesis doctoral Educación patrimonial y diversidad: evaluación de programas y definición de un modelo basado en los procesos de patrimonialización." *Her&Mus: heritage & museography* 15 (2014): 88-89.

Some of the children who took part in the workshop, before it started.

relationships of heritage values to foster sensitivity, awareness and commitment to the significance and profound meaning of the assets.

Therefore, awareness workshops linked to potential heritage education actions are devised as spaces for reflection, discussion, and training, with the aim of valorization and interpretation of specific cultural assets. Nevertheless, the location where these workshops were held – a tiny village in Burkina Faso – and the building material to be assessed – earth as a local traditional resource – pave the way to further reflection on the combination of teacher/student/content/context.

Mural painted by the children using earth in different colours.

Materials used in the workshop.

The professionals involved in the children's workshops in Baasneere, highly experienced in heritage education and especially trained in educational activities linked to earth as a constructive material, have been faced with the challenge of adapting and restructuring other educational experiences[148]. For this reason, the

148 Camilla Mileto, Fernando Vegas. *Diseño, desarrollo y puesta en marcha de la maleta educativa de apoyo a la arquitectura tradicional*. Ministerio de Educación, Cultura y Deporte, 2016. http://www.culturaydeporte.gob.es/planes-nacionales/dam/jcr:e09e72b3-e55f-4db6-ad61-143200a87dd9/2016-maleta-educativa.pdf. Camilla Mileto, Fernando Vegas, Valentina Cristini, Lidia García, Esther Blanco Tamayo. *TAP-TAP. Guía didáctica para*

Workshop on earth as a material for construction.

experience in Burkina Faso has required the content to be adapted to receiver students and contexts far removed from the dynamics usually observed in Europe.

For the children of Baasneere earth is an element which is very much a part of their everyday lives. This somewhat anodyne material does not inspire play or stimulate specific dynamics for interaction among the local children. Hence the attempt – through these workshops – to recover concepts such as local tradition, the development of trades, harmony with the environment, and adaptation to place.

actividades infantiles de sensibilización hacia la arquitectura de tierra. Argumentum Ed., 2017, https://resarquitectura.blogs.upv.es/files/2019/06/TAP-TAP.pdf

One of the models built during the workshop.

Children building model houses using the materials collected.

The structure of workshops

The workshop organized for the children of Baasneere aimed to encourage young people to value and appreciate traditional earthen architecture, characteristic of their country, as well as the constructive techniques used in the project for the secondary school, which the children will attend in the future. One of the main objectives of these workshops is to maintain a playful atmosphere to motivate, prompt, suggest and lead to interest in earth as a constructive material. The workshop lasted two days and involved different activities. On the first day

Children building model houses using the materials collected.

of the workshop, the properties of earth were discussed, and topics such as its colour, texture or composition were explained in simple terms. A brief initial explanation of earth and its variations in tone helped children understand the reason for painting with different materials and shades of earth.

Working in groups, children set out to find earth in three different colours and take it back to the classroom, where the size of the grains of earth was briefly explained to them. A brief introduction to the concept of granulometry helped them to understand the sifting operation, using a sieve to separate the different sizes of grain and see what the local raw material is made of. Together, the children painted a large mural on a white fabric to decorate the school using the Baasneere earth samples brought in by the different teams and others prepared for the workshop.

On the second day, the activities examined earth as a constructive material. The workshop began with a brief explanation of traditional dwellings in different parts of the world to show how local materials are used for construction in all these places. The aim of this explanation was to make the children understand which buildings in their village are traditionally built with earth, showing them in a simple way how this material can be used in construction. After this explanation, a game illustrating bonding used small wooden blocks to help them understand the constructive logic of the school in Baasneere. The aim of this was to show how adobe bricks and CEBs can be used in the same way, although the latter are a technical improvement over traditional adobe bricks.

Furthermore, the children searched for natural materials in the village. For this task the children were organized into groups and handed a card with an image of the different materials. Each group had to find the material which appeared in their photograph and take it to the classroom to show it to the rest of the class. The final task in this activity was to organize the materials collected by all the groups by colour, texture, and size, before going on to play and identify each material with their eyes closed and build a model of a small house.

Reflections

The workshops proposed follow the logic of cultural "literacy"[149], which insists on reinforcing – in this instance among the children of Baasneere – an interpretation and understanding of surroundings, to encourage an in-depth view of the origins of the autochthonous materials, understanding their potential, construction dynamics, and processes.

Different pedagogic studies[150] confirm that during childhood the brain is far more receptive to all types of learning and new experiences. Children usually display a subconscious need to absorb new information through different processes of observation, participation and exploration.

This helps them become empowered individuals, able to encounter a deeper intercultural vision of earth as a constructive material, leading to an active understanding of the village and its past, present, and future. In this regard, these pedagogic actions help the children "take ownership" of earth as a constructive material. This in turn confers dignity to autochthonous features and encourages social dynamics, boosting active participation, critical appreciation and awareness among the village children.

[149] Teixeira, Simonne. "Educación patrimonial: alfabetización cultural para la ciudadanía". *Estudios pedagógicos* (Valdivia) 32.2 (2006): 133-145

[150] Piaget, Jean. *La representación del mundo en el niño*. Ediciones Morata, 1933. Montessori, María. *La mente absorbente del niño*. México: Diana, 1949.

Some of the children who took part, after the workshop.

Sunset in the province of Sanmatenga.

21. Perspectives

This experience of cooperation in the village of Baasneere in Burkina Faso opens up a wide range of perspectives. However, this book does not examine this experience alone, it also addresses broader global frameworks such as concepts, reality, results, and effects of cooperation architecture, and the benevolence and opportunities offered by new earthen architecture.

The increasingly popular phenomenon of cooperation architecture in developing countries has been analysed from various angles, on an international level, in Africa and in greater detail in Burkina Faso. This makes one question whether such architectural experiences make sense, and above all when and under what conditions they acquire value and meaning. Without a doubt, the power and local impact of cooperation architecture increases in step with the frequency and quality of its response to local needs, its use of constructive materials and local resources, and its active involvement of the local population.

Secondly, in most developing countries, especially in Africa and specifically in Burkina Faso, new earthen architecture is proving to be more than just an optimum response to the current pressing environmental, sociocultural and socioeconomic needs affecting us all globally. It is also an affordable solution, which makes a case for empowerment and is a way of preserving and seamlessly connecting local constructive tradition with contemporary construction.

Construction work on the village school in Baasneere has continued in parallel with other cooperation actions championed by the NGO Algemesí Solidari. This book only covers the situation up until the time of publication, but the collaboration continues. Despite the vicissitudes resulting from terrorism and the current conflict in the country, these actions have changed the social prospects of its residents, who attach importance to the fact that their sons and daughters can access higher education. This decision has made and continues to make its mark on people, regardless of the fact that the village has temporarily been forced to evacuate due to violence and intimidation. Even in these trying times, for residents, there are hopes for the future.

Decorative plant with pink flowers in a city garden in Ouagadougou.

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The authors

Camilla Mileto, Fernando Vegas, Lidia García-Soriano, Valentina Cristini and Adolfo Alonso Durá are professors at the Universitat Politècnica de Valencia.

María Lidón de Miguel and F. Javier Gómez-Patrocinio hold PhDs from the Universitat Politècnica de València.

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BURKINA FASO

ARCHITECTURE, CULTURE AND COOPERATION

Camilla Mileto | Fernando Vegas | Lidia García-Soriano (eds.)

This book aims to pay homage to the people, culture and traditional architecture of Burkina Faso, a country with an extraordinary wealth of construction cultures. Through cross-referencing and analysis this book provides an overview of the architectures of the Birifor, Bobo, Dogon, Gan, Kassena, Ko, Lela, Lobi, Mossi, Nuna, Peul, Puguli, Senufo and Tuareg, offering a series of interpretations. It examines habitat, construction materials, elements, space and notions underlying their vernacular architecture, types of buildings and built heritage as well as the weaknesses of their state of conservation and maintenance. It also presents a reflection on the concept and history of cooperation architecture in the country as a preamble to the description of the development cooperation project carried out by the Universitat Politècnica de València in the village of Baasneere.

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