

TOMASZ GACZOŁ\*

## SCHOOL BULDINGS IN GANDO. BURKINA FASO

### BUDYNKI SZKOŁY W GANDO. BURKINA FASO

#### Abstract

School buildings in Gando, Burkina Faso, Africa have been designed by Diébédó Francis Kéré. The architect, who comes from this area, has been designing objects making the most of the available local material and local labour force. The simple architectural forms, clear function and technical solutions stay in perfect harmony with the issues of the climate prevailing there, as all the buildings were based on the idea of natural ventilation. Awarded numerous times, they are an example of sustainable architecture serving the local community.

*Keywords: natural ventilation, airing, microclimate*

#### Streszczenie

Budynki szkoły w Gando w kraju Burkina Faso w Afryce zostały zaprojektowane przez Diébédó Francis'a Kere'a. Pochodzący z tego rejonu architekt projektuje obiekty, wykorzystując dostępność lokalnego materiału oraz miejscowej siły roboczej. Proste architektoniczne formy, jasna funkcja oraz techniczne rozwiązania doskonale współgrają z zagadnieniami panującym tam klimatu. Wszystkie budynki powstały bowiem w oparciu o ideę naturalnej wentylacji. Wielokrotnie nagradzane są przykładem prostej zrównoważonej architektury, służącej lokalnej społeczności.

*Słowa kluczowe: naturalna wentylacja, przewietrzanie, mikroklimat*

\* Ph.D. Eng. Arch. Tomasz Gaczoł, Faculty of Architecture, Cracow University of Technology.

## 1. Diebedo francis kéré

Diébédo Francis Kéré is an architect from Burkina Faso. He was the first from his village to be sent to Europe where he studied at the Technische Universität in Berlin. He knew well that only he could have a positive impact on improving teaching conditions in his village and across the country. He felt responsible for the entire community of the village and he knew that in order to repay a debt of gratitude, he should help those people. Therefore, his main objective was the development of education. The aim of Kéré's designs are: climatic adaptation, low cost of construction and his own labour during the construction works. In carrying out their projects he involved the local community, which taking part in the building process, can maintain and spread the word about these objects. While he was studying, he set up an association called "Schulbausteine für Gando eV", was already collecting funds to finance his first project, a primary school in his home village. The building was completed in 2001 and received the Aga Khan Award for its concise and elegant architecture, created with the use of basic tools. The school is the result of a vision, initially verbalised by the architect, but ultimately realised by the community. The jury assessed the great potential of the design, which helps the community develop a healthy sense of pride, hope and unity, while creating a solid foundation for the development of the society. The fact that Kéré built a primary school for Gando exemplifies his commitment to education. This was the first of many awards, while others included the Global Award for Sustainable Architecture in 2009 and the BSI Swiss Architectural Award in 2010. Awarded many times, Kéré combines research and experience as a lecturer at the Technische Universität in Berlin and as an architect in his own studio. His research contributes to the impartial development of strategies for architecture with local character. Kéré has defined himself as "a cultural bridge between technically and economically" developed countries and less-developed African countries

## 2. Primary school in Gando, Burkina Faso

In 2008, a new primary school, intended to accommodate 280 pupils from the village and the surrounding areas, was built in the village of Gando in Burkina Faso. It was designed by Kéré, an architect living in Berlin, who comes from Burkina Faso and very well knows the climatic conditions prevailing in that part of the world very well. A simple form of the object, based on a rectangular plan, is made of compressed earth blocks – a material characteristic of the region, which serves as an excellent heat insulating barrier between the interior of the object and the external space. The building is characterized by a narrow and elongated shape, and the classes inside, thanks to the window openings, are aired throughout. The windows are fitted with openwork, colourful, folding shutters. Their main advantage is to allow the air to permanently flow freely, in spite of the closure. In the gable walls, and in the first layer of the clay roof, there are large vents for the drainage of waste and hot internal air. In the middle of blocks, which he designed, there is a roofed, open space where, in a small amphitheatre-like cavity, children can play between lessons. Presumably, this cavity acts as a reservoir for the coolest air where the children and teachers can rest. The whole building is covered with a barrel roof made of the same material as the walls. A lightweight steel truss dominates above the brick structure of the object, lifting the corrugated metal roof with wide, shading eaves. It is a ventilated roof that functions perfectly well on hot days (Ill. 1–7).



III. 1. School in Gando, Burkina Faso. Ventilated roof space  
(source:[1])



III. 2. School in Gando, Burkina Faso. Colourful, openwork shutters  
(source: [1])



III. 3. School in Gando, Burkina Faso. Classroom with a prominent barrel vault, which contains ventilating holes  
(source: [1])



III. 4. School in Gando, Burkina Faso. The facade of the building  
(source: [1])



III. 5. School in Gando, Burkina Faso. The amphitheater recess, covered with steel roof truss  
– a playground and a meeting place for children  
(source: [1])



III. 6. School in Gando, Burkina Faso. A view of the object  
(source: [1])



III. 7. School in Gando, Burkina Faso. A view of the object  
(source: [1])

### 3. Lower secondary school building, Burkina Faso

An increase in government funding for secondary education in 2010, enabled fifty students to begin classes. While waiting for the new school building and new classrooms, their lessons were held in the primary school. The construction of a secondary school building began in May 2011 and was finished in 2013. This is Kéré's biggest project up-to-date. The new building complex consists of twelve classrooms, a library, an administrative building and several sports fields. It will be able to accommodate approximately 1000 students. The arrangement is inspired by the traditional rural households in Burkina Faso: the classrooms are set out in a circular fashion forming a courtyard, shielding it at the same time from the dust and sand brought by the winds. The structure is open on its west side, allowing a cool breeze to enter the area. High temperatures, large class sizes and lack of air conditioning in Burkina Faso make it very difficult for students to concentrate during classes. Therefore, an innovative air cooling system was developed making use of only natural ventilation. The school is surrounded by a bank of earth, on which trees providing shade were planted. Rainwater for watering plants is gathered by a perforated pipe in the ground. The air flowing through the piping system is also cooled and emerges in the classrooms through the holes designed in the floor. The use of the same steel roof construction as in the primary school building, in the form of a wide corrugated iron roof raised above a clay ceiling vault, sets the circulation of heated air between ceiling and roof in motion, creating a suction current. This causes that the cool air flowing from the under-floor pipes to rise, reducing the room temperature by about 6–8°C (III. 8–10). With simple yet effective methods such as these, the school requires little electricity both in construction and maintenance.



III. 8. Lower secondary school in Gando. Burkina Faso. Schematic natural ventilation school  
(source: [6])



III. 9. Lower secondary school in Gando. Burkina Faso. School building during construction  
(source: [6])



Ill. 10. Lower secondary school in Gando. School building during construction. Photo from the embankment (source: [6])

#### 4. Teachers housing in Gando, Burkina Faso

The teachers' houses were designed to attract teachers out to the countryside, as well as to promote the use of earth as a sustainable and durable building material. Single modules can be combined in various ways into a larger composite whole in order to obtain additional living space. The simplicity of the design and minimal use of bought materials means that the objects can easily be constructed. The six houses for teachers and their families are arranged in a wide arc to the south of the school complex. . The roofs are barrel vaults constructed from stabilized earth blocks. This construction method, previously unheard of in this region, causes local resources to be used and this is the right direction in the process of building. To protect the building from rising dampness, the 40 cm thick adobe walls stand on a foundation of cast in-situ cement and stones. A tie beam connecting the walls bears the roof load in each module. The roof is a layer of reinforced concrete poured in situ into a permanent shuttering of compressed stabilized earth blocks (CSEBs). For better thermal insulation clay elements are laid on reinforced concrete structures. The steel roof construction height alternates between 100 cm and 150 cm and serves as a means of natural ventilating and shading of the front facades creating a friendly microclimate inside. Wide roof overhangs protect the walls from moisture and rain. The walls of traditional houses are impregnated with a mixture of vegetable juice and cow dung. Unfortunately, these treatments are of little use in the rainy season and attract termites which can eventually destroy the walls. In these buildings, the traditional protection against dampness was replaced with bitumen laid at the intersections of the barrel roofs. The culmination of building work is the tamping of the clay floor to create a smooth, homogeneous surface. The enthusiastic involvement of the people of Gando was the key to the success of this project. The villagers gained not only new skills, but also a sense of responsibility, awareness and sensitivity to both the traditional and the innovative building techniques (Ill. 11–13).



Ill. 11. Teachers housing in Gando, Burkina Faso. Openwork, ventilated front elevation  
(source: [8])



Ill. 12. Teachers housing in Gando Burkina Faso. Visible channels to drain and collect rainwater  
(source: [8])



Ill. 13. Teachers housing in Gando, Burkina Faso. Double-layer barrel ventilated roofs  
(source: [8])



## 5. Library building in Gando, Burkina Faso

A public library was designed next to the school by the same architect. The building has an elliptical shape and is made of clay brick, an accessible, local material. Thick walls are virtually devoid of windows, thus creating a human friendly microclimate inside the building. Additional interior lighting is achieved by designing round holes in a flat roof, performing the function of ventilation ducts and natural ventilation. The shape and structure of the roof covering, make this a very interesting object due to the material used and the architect's unique idea. The use of traditional clay pots to create holes for light and ventilation is a unique phenomenon in the world. The clay pots were brought to the site by local people, then cut appropriately and placed on the formwork between the structural beams. Once prepared, the roof was covered with concrete, thus creating the possibility of vertical ventilation of the building and its indirect illumination. A rectangular lightweight steel ventilated roof sits above the whole structure and extends out beyond the library. The contour of the roof is connected to the vertical, openwork, eucalyptus elements. They provide additional shade and favourably influence the microclimate of the interior favorably (Ill. 14–17).



Ill. 14. Library in Gando. Burkina Faso. Top view of a ventilated roof  
(source: [2])



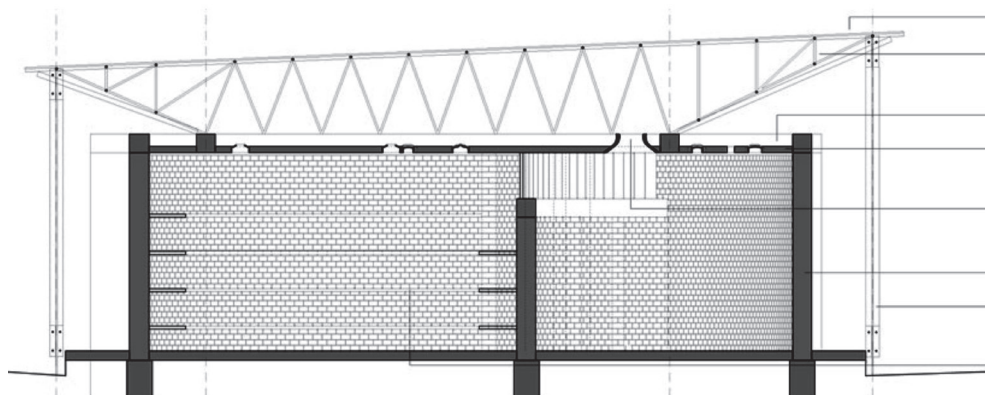
Ill. 15. Library in Gando. Burkina Faso. From left: Main room of the library with a perforated, ventilated roof, rural community carrying clay pots used to build the library (source: [2])



Ill. 16. Library in Gando. Burkina Faso. From left: Arranging trimmed ceramic vessels in the reinforcement of the floor slab and the finished floor (source: [2])



Ill. 17. Library in Gando. Burkina Faso. Computer visualization of the facility and its cross-section (source: [2])



III. 17. continuation

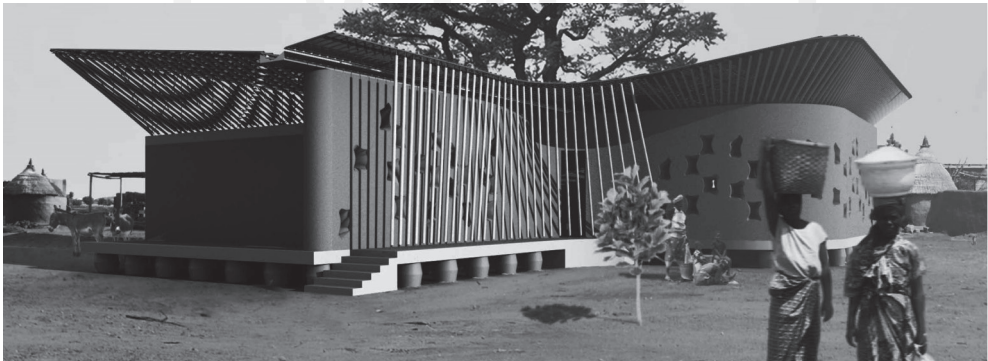
## 6. Women's association centre, Gando, Burkina Faso

A new Kere's project, which was launched in 2012, is a building designed for women. The programme of the building includes a classroom, a meeting room, an office, a kitchen and sanitary latrines. Furthermore the centre contains a storage room for agricultural goods and household effects. This offers new possibilities for the women to store their harvested goods, then process them further and sell them later at the market to secure their own incomes. Designed in an interesting way, big clay pots are contained in the thick, massive, earthen walls. They are like shelves for storing food products. Steel roof structure supported by wooden beams, on which there are also laid open-work earthen vaults, creates a thermal barrier. Voids located in ceiling gaps, allow air to circulate through the interior storage and meeting places. From October to May, the building will be used for educational purposes. Classes for adults will take place from 7am to 2pm. In the afternoon until sunset, the building will be open to the village community and used especially by the women's association for various activities. During the rainy season from the end of May until the end of September, which is the high season for agriculture, the building will be used for information and campaigns which can be initiated by the village community, the regional government or foreign organisations. During the rainy season, the women's centre will be the only facility that will provide a dry space for the storage of goods and social events related to this. The building should incentivise the government and other non-governmental organisations to allocate more funds essential to educate professionals in the fields of healthcare, development, agricultural technology, education, water management and forestry. The target group of the project is a community of up to 300 women from the village of Gando and the surrounding area in the province of Boulgou in Burkina Faso. This area includes about 2,500 people, most of whom make their livings as subsistence farmers. In this region, women are bearing the brunt of poverty as up to 97% of the women over 15 years old are illiterate. To effectively combat this, the women want to form a strong social and economic union. The women's association centre will improve their quality of life in a sustainable way by providing a platform for them

to develop their economic and educational situation, health, nutrition and agriculture. The village community will contribute to the building through voluntary efforts, which will keep construction costs low. (Ill. 18–19).



Ill. 18. Women's Association Centre in Gando. Burkina Faso. Casting of clay vessels used to store food products in the wall (source: [7])



Ill. 19. Women's Association Centre in Gando. Burkina Faso. Computer visualisation (source: [7])

## 7. Conclusions

The conclusions that come to mind are first of all: proper selection of appropriate design solutions to the prevailing climate. The correct choice of building materials, minimized the costs involved in the creation of these objects. Local availability of materials and the use of local community's labor, which after appropriate training in construction techniques, was

able to participate in the creation of these objects, and of many more in the future. Obviously, a sense of responsibility and an awareness of a job well done, are the elements that allow you to break out of the generally prevailing poverty, frustration, despondency and depression. This aspect is the most important one in the whole project.

The whole building complex is an example of contemporary architecture with very interesting forms, which were created from building materials available in the area, gathered by the local community during its construction. Climatic conditions imposed a method of architecture, which shaped the author to these objects. Simple form and construction techniques are the answer to the question: "How should buildings be designed in this area?" It is the idea and direction worth following, which can also function well, in other geographical, cultural and social areas.

## References

- [1] <http://www.kerearchitecture.com/projects/school-extension-gando/>
- [2] <http://www.archdaily.com/262012/in-progress-school-library-gando-kere-architecture/>
- [3] <http://archleague.org/2012/02/francis-kere/>
- [4] <http://www.e-architect.co.uk/events/diebedo-francis-kere-lecture>
- [5] <http://lc-architects.blogspot.com/2013/01/escuela-de-tierra-gando-burkina-faso.html>
- [6] [http://en.wikipedia.org/wiki/File:Kere\\_Secondary\\_school\\_gando.JPG](http://en.wikipedia.org/wiki/File:Kere_Secondary_school_gando.JPG)
- [7] <http://www.kerearchitecture.com/projects/womens-association-centre-gando/>
- [8] <http://www.kerearchitecture.com/projects/teachers-housing-gando>