2019 On Site Review Report

by Aziza Chaouni

Alioune Diop University
Lecture Building

Bambey, Senegal

Architect
IDOM

Client
ACPBE, Ministry of Urbanism, Ministry of Higher Education

Design
2012-2013

Completed
2017
I. Introduction

Located in the town of Bambey, this 203-metre-long Training and Research Unit (TRU)* for the Alioune Diop University is composed of a 500-seat amphitheatre, five classrooms of 50 students, eight classrooms of 100 students, three laboratories, ten offices for professors and two meeting rooms. Organised according to a 3.6-metre structural grid, the building is composed of five sub-units punctuated by staircases. It uses a simple post-and-beam reinforced-concrete structure infilled with breezeblocks. The project strategy to handle the local hot climate involves a double roof system and a double-skin south façade. A metallic roof held by metal trusses floats above the sub-units’ insulated roofs, while the southern façades are protected by a continuous lattice wall, built using prefabricated perforated breezeblocks.

Finally, grey and black water are filtered with an activated sludge system, then the resulting decontaminated water is channelled towards basins filled with gravel and vegetation.

II. Contextual information

A. Brief historical background

With a population of 20,000, Bambey stands out for its peanut and cattle farming, its scarce urban infrastructures and harsh arid climate and landscape. The creation of the campus of the Alioune Diop University in Bambey, 5 kilometres from the town’s core, resulted from a strategy of the Ministry for Higher Education of Senegal to decentralise higher-education provision in order to not only encourage retention of youth in rural areas, but also provide specific education and training programmes suited to the needs of these areas. As a result, the regional teaching centre in Bambey was transformed in 2007 into a university. 700 students were initially enrolled. Due to pressing demand, more and more students enrolled and in 2012, 2,060 students attended the Alioune Diop University. Meanwhile, the existing facilities were not extended and were functioning beyond capacity.

Before the TRU project was launched in 2012, the Alioune Diop University, which covered 62 hectares, was comprised of administrative buildings, a 200-seat auditorium, two dormitories for 100 students each, a restaurant, seven general classrooms, two computer labs, one library (with a capacity of 300 people), nine classrooms for 50 students, and sport fields.

Therefore, an extension project was launched by the Ministry for Higher Education and financed to service 1,500 additional students. The World Bank financed the largest part of this section, the Training and Research Unit (TRU) which was to comprise lecture rooms for 50 and 100 people, a 500-seat lecture hall, laboratories, computer rooms and offices for the teaching body, all distributed over an enclosed built-up area of 4,200 square metres and 11,500 square metres of urbanised area.

* In French: Unité de formation et de recherche (UFR)
B. **Local architectural character, including prevalent forms and materials**

Bambey is a rural urban centre, composed of a recent core and surrounded with small traditional households. Bambey’s core is comprised of single-storey houses built using a typical concrete post-and-beam structure with breezeblock infill. Breezeblocks are made locally at construction sites or at the workshop of a craftsman who then sells them. The concrete used to make the blocks is produced in Dakar. Homes generally have a courtyard. Façades are either painted or covered with cheap ceramic tiles, usually used in bathrooms. No insulation is used on roofs or along the walls.

Of note are prefabricated perforated blocks which are used to create screens to simultaneously provide visual separation and ventilation, in courtyards or kitchen spaces.

On the outskirts of Bambey, one can find beautiful examples of local architecture: huts, usually inhabited by low-income families of herders. These huts showcase circular or rectangular plans, a wooden structure, walls covered with branches of acacia, and a roof in thatch with vetiver reeds. The huts are usually surrounded by a fence made out of acacia reeds, forming a yard. They are usually households, but they sometimes serve as animal sheds while families live nearby in a newly constructed concrete and breezeblock home. Similarly, the hut can be used as an annexe of the household, usually a bathroom or a kitchen.

Today, some huts are hybrids: they follow the traditional plan and shape while sporting corrugated metal roofs, walls and fences. The abandonment of the traditional architecture of the hut, well suited to Bambey’s hot climate since its walls allow for passive ventilation, is symptomatic of changes in mentality: metal and concrete are viewed as synonymous with progress, while reed-covered huts represent backwardness.

Inside Bambey and on its outskirts an interesting phenomenon is of note: single trees, baobab or acacia, standing in an arid setting and forming a welcoming cool shaded area – a popular public space in itself. As such, I consider the tree and the space beneath its canopy as local architectural features, since they clearly form a physical space, used daily by locals.

C. **Climatic conditions**

Senegal has a humid climate and very high rainfall. Average yearly temperatures are between 23°C and 30°C, the average maximum yearly temperature being placed around 38°C and minimum around 16°C. The rainy season lasts from June to September. Breezes are rare. 90% of wind is hot in Bambey.

Solar trajectory in Bambey:

- The ideal orientation for buildings is north–south, since it is easy to protect them from solar radiation by static measures such as overhangs or sunshades.

- The east and west façades are more difficult to protect, the ideal approach being for them to have no openings. If this is not possible, a sunblind (vertical or horizontal, depending on the characteristics of the building) is the best solution to prevent solar incidence. It is however necessary to take into account that installing one will reduce the levels of natural lighting.
### D. Immediate surroundings of the site, including architectural character, access, landscaping, etc.

The University grounds are fenced and the entrance is monitored by a security guard (blue arrow in the site plan). Only students with ID cards, administrators and teaching staff are allowed in. The north-eastern part of the campus has a well-maintained shrubby landscape and a pedestrian system, yet mature, leafy trees with canopies are severely lacking. As one heads west after entering the campus, the gardens and path system start to fade away, giving way to a dusty, arid landscape with sparsely distributed acacia trees. The new extension of the campus is located in this desolate western section of the campus (delineated with a dotted orange line in the site plan). The TRU is situated south of this extension.

The campus lacks clear organisation, and way-finding is difficult due to the absence of circulation hierarchy and logic. Buildings seem to be randomly laid out, yet a general east–west orientation seems to dominate. The building density remains low as large spaces are left between buildings, preventing the creation of a cool microclimate within the campus. The University’s Dean confirmed that the campus did not have a masterplan and that new buildings were randomly placed, based on immediate needs.

All the buildings of the Alioune Diop University, beside the new Lecture Building, were erected between 2004 and 2009. The classrooms, labs and dorms are linear buildings serviced by open-air corridors, the administration buildings are around a central courtyard, while other buildings are simple concrete “boxes”. None of these pre-existing buildings have any particular architectural quality of note.

The campus buildings were constructed with a concrete post-and-beam structure, breezeblock infills and floor slabs composed of reinforced-concrete joists and hollow slabs (hourdis). The façade walls are built with breezeblocks covered with mortar coating on the exterior, and plaster or mortar on the interior depending

<table>
<thead>
<tr>
<th>Site plan:</th>
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<tbody>
<tr>
<td>1 – dorms</td>
<td>7 – main administration building</td>
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<tr>
<td>2 – café</td>
<td>8 – classrooms</td>
</tr>
<tr>
<td>3 – old library/administration building</td>
<td>9 – Training and research Unit (TRU)</td>
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<tr>
<td>4 – new lab buildings</td>
<td>10 – TRU water filtration system;</td>
</tr>
<tr>
<td>5 – new library</td>
<td>11 – mechanical room</td>
</tr>
<tr>
<td>6 – temporary prefabricated classrooms</td>
<td>12 – sports fields</td>
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</tbody>
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[Image of site plan with labels for dorms, café, old library, new lab buildings, new library, temporary classrooms, main administration building, classrooms, TRU, TRU water filtration system, mechanical room, and sports fields.]
on the areas. There is no thermal insulation. The roofs are horizontal concrete slabs with a bituminous
waterproofing layer, except for certain buildings (such as the restaurant and the amphitheatre) where the
roof is sloped with a steel structure and corrugated metal cladding without insulation.

Overall, the designs of the campus buildings do not take into consideration basic principles of sustainability,
such as orientation, passive ventilation or insulation. As such, air-conditioning or fans are a must, and in
the event that they stop functioning, thermal conditions inside classrooms become unbearable. Besides, the
quality of construction is very low: the buildings were already starting to fall apart when they were only a
few years old. For instance their façade paint flakes away, their floor tiles are broken, exposed electric wires
hang from walls and ceilings (since they were not included in the design to start with), water leaks from
roofs, mould creeps across dislodged ceiling panels, etc.

Only two buildings stood out and somewhat inspired the architect of the TRU project: the old library
building, which has a nice perforated breezeblock wall protecting its courtyard; and the main administration
building, which is organised around a pleasant planted courtyard.

E Topography of the project site

The project site is rectangular and oriented east–west. The middle third of the site is relatively flat: it is 60
centimetres higher than the eastern part of the site, and 1.5 metres higher than the western part of the site.

III. Programme

A. History of the inception of the project, how the project was initiated

Under the “Financement et Gouvernance de l’Enseignement Superieur” (Financing and Governance of
Higher Education) programme started in May 2011, the Ministry for Higher Education of Senegal started
surveying the needs of universities across the country. One of the major needs that they established
was to increase student capacity. As a result, the Agence de Construction des Bâtiments et des Edifices
Publics (ACBEP; Agency for Construction of Public Buildings and Edifices), an agency housed under the
Ministère du Renouveau Urbain, de l’Habitat et du Cadre de Vie (Ministry of Urban Renewal, Housing
and Living Environment), launched five requests for quotation (RFQs) for new buildings. The Training
and Research Unit (TRU) is the result of one of the RFQs, which took place thanks to a World Bank loan
to the Government of Senegal. This new building was intended to house students studying sciences and
Information & Communications Technology (ICT).

B. How were the architects and specialists chosen?

The architects were selected based on a reference list of similar projects, team members’ qualifications,
financial capacity, line of credit, and proposed bids. My discussions with two local architects confirmed that
this selection process automatically excluded most local architects from participating.

C. General programme objectives

The key objective was twofold: to provide classrooms in order to enrol 1,500 additional students at the
Alioune Diop University, and to connect the existing campus to this new building.
It should be noted that the programme provided for the RFQ was limited to the number of classrooms and facilities needed, with no set surface areas nor any defined site for the project.

D. Functional requirements (i.e. architect’s brief)

The Agence de Construction des Bâtiments et des Édifices Publics (ACBEP) RFQ asked for:

- 1,500-seat auditorium
- 14 classrooms
- 10 offices
- 2 laboratories
- green spaces
- parking for 50 cars.

No surface areas were given to the architects.

After the architects IDOM were selected, they developed a revised programme along with the University staff and clients. The final programme included:

- 500-seat amphitheatre
- 5 classrooms of 50 students
- 8 classrooms of 100 students
- 3 laboratories
- 10 offices for professors
- 2 meeting rooms
- 3 technical rooms (electricity, plumbing, and telecommunication/auditorium needs)
- storage room
- mechanical room and generator
- water treatment unit
- rainwater and recycled water basins.

IV. Description

A. Building data: volumetry, massing, number of units, surface in square metres, etc.

The single-storey TRU building is an imposing 203-by-25-metre rectangular volume, covered with a sloped corrugated metal roof, soaring at 9.26 metres on the north façade and reaching 7.85 metres at the south (rear) façade. The large mass of the building is mitigated by its segmentation into five sub-units, composed of four units containing classrooms and teachers’ offices, and one auditorium unit. All units have the same width, and three have the same length, while two (including the auditorium unit) are longer.

Stairs are placed in the four voids between the five units. Breaking this repetition of circulation cores, the east façade, which faces the existing campus, houses a non-covered stair (set along the east–west axis) and a ramp (set along the north–south axis). The placement of these two different circulation cores in this eastern zone helps not only create a seamless connection between the existing campus and the building, but also formally marks the entrance of the TRU.
Surface areas:

- Enclosed surface areas: 4,772 square metres
- Covered circulation: 1,858 square metres
- Non-covered circulation: 265 square metres
- Covered garden and forecourt: 1,614 square metres
- Landscape (basins and rainwater canals): 4,316 square metres

Total: 12,285 square metres

B. Evolution of design concepts, including

1. Response to physical constraints – siting, climate, plot ratios, etc.

   **Siting**
   The architect helped the client and the main stakeholder, the Alioune Diop University, to select a site for the project on the campus grounds. The final decision was to place the new TRU building in the western side of the campus amid its planned new extension, which included two new laboratory buildings and a library. The idea to place the building amid the existing campus core in order to better consolidate it was abandoned due to the poor condition of existing buildings and the lack of sufficient space. The current placement not only respected the existing grid which is slightly off the north–south axis (north-north-east), but it also preserved the basketball and soccer fields which are very popular among students. The downside of such a placement was the closeness to one of the new single-storey lab buildings. The two buildings are only separated by 17.5 metres, a tiny distance given the length and height of the TRU.

   **Plot ratio**
   No plot-ratio or maximum height limits were required by the RFQ or local regulations.

   **Climate**
   The main climatic constraints were (1) the high heat, which can reach 45°C in Bambey in the summer months, and (2) the lack of outdoor shaded areas and vegetation.

   **Infrastructure**
   Other key constraints were the lack of basic sewage infrastructure (all existing campus buildings use individual septic tanks), and the scarcity of road and pedestrian networks. It is important to note that the site is connected to the municipal potable water system and the municipal electricity grid.

   **Vermin**
   Another constraint was the presence of termites, which made the use of untreated wood problematic.

2. Response to user requirements, spatial organisation

   The University administrative and teaching staff wanted classrooms with proper thermal comfort all year round, plenty of natural lighting, easy maintenance, and a good quality of construction.

   Spatial organisation requirements included the separation of teachers’ and students’ spaces, each with its independent access. As a result the architect placed all the teachers’ offices on the first floor of unit 1.
3. **Purely formal aspects massing, articulation of façades, decorative features, use of traditional motifs, etc.**

The architects preferred a centralised building rather than a cluster of separate buildings because they wanted to create a project with a strong, imposing identity, which reflects the status of a high-standard university rather than that of a high school or primary school. Hence, they placed all five blocks close to each other and covered them with a continuous roof. The TRU’s large massing stands in stark contrast compared to the small scale of the other buildings on campus.

The north façade has a repetitive nature: on one hand the units follow a strong 3.6-metre grid, and on the other all windows, doors and circulation cores have similar dimensions. This decision was driven by the architects’ wish to simplify construction. The secondary roof is held up by thin metal columns with three branches, referencing a tree. The striking south façade is composed of a 7.85-metre free-standing lattice wall, pierced at regular intervals by entrance gates. The east façade, facing the existing campus, is also composed of a similar free-standing lattice wall.

4. **Landscaping**

Even though the budget was limited, the architects proposed a set of four basins lined with local volcanic stones held together with cement. The basins follow organic shapes that mimic a river and receive rainwater collected from (1) the building’s sloped roof and (2) decontaminated grey and black water. The soil and water table being saline, care was taken in the choice of vegetation and trees planted. With the help of the Centre of Agricultural Research of Bambey, the architects’ team selected the following plants for the slopes and the bottom of the four basins:

- **Species already existing on campus:**
  - privet
  - laurel
  - *Azadirachta indica*
  - Matalys
  - Milinan
  - *Cordia*
  - sandbox
  - eucalyptus
  - cyclamen
  - *Casuarina equisetifolia*
  - *Calotropis procera*:
    - *Faidherbia albida*.

- **Newly introduced species:**
  - *Acacia andosonii*
  - citronnella
  - Milina
  - Matalys
  - sandbox
  - bougainvillea
  - Acacialasel
  - acacia
  - *Moringa oleifera*. 
C. Structure, materials, technology

1. Structural systems

Concept
The structure of the building’s roof was conceived as a big tree canopy that shelters life underneath it and creates a cool multi-purpose public space that can serve as a waiting area for public transportation, a place of commerce and the sale of food, a prayer space, a car workshop etc. The large-canopied tree as a space of gathering is very present throughout the country and anchored in Senegalese life, especially in rural areas such as Bambey.

The shape of the flying roof columns, which emulates a tree trunk and its branches, strongly marks the identity of the project as a whole. These columns, spaced every 7.2 metres, hold an imposing 10-metre-tall and 203-metre-long roof formed by corrugated metal sheets and steel trusses, from which colourful fins are suspended. These fins reproduce the canopy of a large forest.

The structure of the roof is voluntarily left exposed in order to offer a spatial understanding of all the elements that constitute it.

The buildings beneath the roof forming the five sub-units have a concealed post-and-beam concrete structure.

Modularity
By making the structure of the building modular, the architects aimed to optimise and simplify the construction process. Thus, the columns and beams are oriented in a repetitive 3.6-metre grid, which allows the standardisation of the foundation footings, columns and beams used throughout the project.

In addition, this 3.6-metre grid, divisible by 0.6 metre, allows the synchronisation of the module of the suspended ceiling panels with the structural grid, thereby avoiding the trimming of panels and limiting material waste.

2. Materials

Structure
The main structure is made of reinforced-concrete posts and beams with reinforced-concrete floor slabs cast on site. The secondary roof structure is composed of a metal frame. The foundations are shallow, with continuous footings around the perimeter and isolated footings in the centre.

The floor slab of the ground floor is raised and sealed in order to prevent rain damage. It rests on sills and compacted earth.

The floors are composed of (1) semi-prefabricated concrete beams made on site, and (2) hollow precast concrete slabs (hourdis) made in professional workshops off site, with compression slab.

The structure was chosen based on local technologies and know-how.

The south lattice façade is braced by I-beam columns which are at the same time connected diagonally to the main concrete structure by means of hollow structural circular sections to counter wind loads.
Regarding the southern free-standing screen wall, each horizontal layer of its breezeblocks is reinforced by a 4-millimetre welded mesh, embedded in the mortar layer and anchored to metal studs for bracing. These studs are connected to steel columns.

**Roof**

The roof is composed of corrugated metal sheets held with steel trusses in order to lighten its weight and permit large spans, especially for the north-facing outdoor space. The trusses become skinnier as they reach the edge of the roof canopy. Also, the trusses connect to the tree-like steel columns on the north façade, to regular steel columns on the south façade and to concrete columns in the central area of the building. The tree-like columns come in two types that randomly repeat throughout the length of the building.

**Beams**

60-centimetre deep beams, including the floor slab thickness.

**Infill materials**

- Facade of classrooms: precast concrete breezeblocks prefabricated in Senegal, 20 centimetres wide.
- Interior partitions between classrooms: double wall of precast concrete composed of 15-by-5-centimetre concrete aggregate blocks and mineral wool for acoustic insulation.
- Roof: thermally insulated waterproof roof made of a composite system of (a) a waterproof double bituminous membrane and (b) an 8-centimetre layer of mineral wool supported by a steel tray.
- South façade: 20,000 perforated 60-by-30-by-20-centimetre breezeblocks, with triangular openings, prefabricated on site with a double steel mould.

**Renderings and finishes**

- Façade of classroom:
  - Two layers of cement plaster (raw and fine).
- South and east façades:
  - The breezeblocks of these façades are finished in white cement mortar dyed with local sand applied by a manual spray machine (tirolienne.)
- Interior joinery:
  - Fir-wood doors with anti-termite treatment, two layers of varnish and finishing paint.
- Exterior joinery:
  - Window frames are in anodised aluminium profiles (standard Technal). Glazing is double laminated, 3 + 3 millimetres, with PVB (poly-vinyl-butyral) interlayer, translucent or transparent according to the height to ensure visual intimacy without diminishing the entrance of natural light.
- Exterior joinery:
  - Doors are 45-millimetre solid wood with a wood laminate finish.
- Flooring:
  - The flooring of the classrooms, amphitheatre and offices is in quartz-type “terrazzo” 30-by-30-centimetre panels with 30-millimetre silicone joints.
  - The flooring of the toilets is 45-by-45-centimetre porcelain tiles.
  - The floor of the ramp and the circulation on the ground floor are in white seashell concrete, which is a local speciality (cement is mixed with pieces of broken seashells).
  - The outdoor pedestrian walkways are in grasscrete pavement made on site.
  - The floor and slopes of the 1.5-metre-deep basins for the collection and filtration of rainwater are covered in basalt stone and cement mortar, placed on top of a geotextile membrane.
• Suspended ceiling:
  – In the classrooms: removable 60-by-60-centimetre panels in wood fibre and plasterboard.
  – In the amphitheatre: 60-by-120-centimetre wood-fibre panels (placed on the walls as well) painted and screwed onto a metal frame.

3. Construction technology

The construction techniques used prioritise the prefabrication of materials and construction systems on the site itself, with four key objectives: economy of transport; reduction of delays in production; ease of implementation; and use of mainly manual tools.

A prefabrication unit was installed on site: an area for the production of concrete, an iron workshop for steel rebars, an iron workshop for welding and truss assembly, a wood workshop for the formwork and a workshop dedicated to the manufacture of the perforated breezeblocks for the south façade.

The reinforced-concrete structure was cast on site with the prefabrication of most of its components, such as floor beams, ready-mixed concrete (produced using a 500-litre concrete mixer and a mobile crane for pouring) and rebars assembled from the high-adhesion steel imported from Europe. Only prefabricated floor slabs were delivered from a manufacturing unit in Thiès, located 60 kilometres away.

The metal trusses were also manufactured on site with two types of U channels (UPN), consisting of triangulated frames and welded brackets, assembled on site with 40-ton mobile cranes.

The south façade with its perforated breezeblocks is built according to local techniques used throughout Senegal. The breezeblocks are made using moulds (four moulds were used in total). After pouring the concrete, they are left to dry in the open air, then they are laid using mortar.

Other simple local construction techniques include the white-tinted exterior cement finishes, and the seashell cement flooring.

Regarding the roof, its components – the steel tray holding the insulation, the thermal insulation and the double bituminous membrane (composite deck type) – are commonly used in Europe and were assembled by a specialised company.

Even if the architectural design is innovative for the country, the construction techniques and materials are commonly used in Senegal, which allowed the control of the quality of execution, the limitation of errors and the utilisation of the workers’ know-how. The social component is also favoured by the massive use of local labour.

Regarding the machines and equipment used during construction of the site, they are equivalent to those used in developed countries: fixed and mobile 40-ton cranes, dumper-type machine trucks, etc.

4. Building services, site utilities

The choice of building services and utilities was made on the basis of the constraints of the existing campus infrastructure, ease of maintenance and maximum energy savings.
Constraints include: the non-existence of a sewage system and rainwater collection system; a very low flow of potable water supply; frequent power cuts; and limited university human resources for maintenance.

To meet these challenges, the project services and utilities were as follows:

• Rainwater is recovered by a single longitudinal gutter located along the southern edge of the roof and evacuated by 200-millimetre PVC pipes. Hidden inside the double-layered south façade, these pipes were dimensioned to cope with heavy rainfall. The water is then poured into a stone trench leading to four filtration basins. These pools are levelled 20 centimetres apart and fed through the natural slope of the site. The last basin, located the farthest west, has an open end in order to evacuate excess water towards the natural ground.

• The building’s wastewater is channelled to an anaerobic treatment plant with activated sludge. Once treated, the purified water passes through a last sand filter to remove pathogens, before being poured through a buried pipe system into a filtration basin.

• Individual air-conditioning units are installed only for the teachers’ offices and the amphitheatre, and even there only because the University requested it. Indeed, the bioclimatic design of the building by means of the system of double-layered façade and double roof already allows for sufficient thermal comfort without needing cooling systems for all interior spaces, since the whole envelope repels direct solar incidence onto the inner building envelope.

Passive strategies ensure that interior temperatures never exceed 25°C, when outdoor temperatures are 40°C or more.

All rooms have passive ventilation and are equipped with ceiling fans, with very low power consumption, which further improves users’ comfort.

The air-conditioning units are placed on the building’s interior roofs, along the corridor for simple and direct maintenance.

A centralised air-conditioning system would have offered a better yield but would have needed more complex maintenance and risked remaining broken if a problem should arise.

The condensation water from the air-conditioning units is directed into the filtration basins.

• The lighting fixtures follow typical European standards. Lighting fixtures are fluorescent for reasons of local availability in the market.

• Electricity: there is a supply of medium voltage thanks to an autonomous transformer located at the edge of the campus. A power generator is coupled with the transformer and inverters in order to protect the building’s electrical system. The distribution board is in a dedicated room on the ground floor.

• Fire protection: the building was designed according to European architectural standards and its plans were approved by the civil protection services of Diourbel (a town located 30 kilometres from Bambey). The TRU building has fire extinguishers, signage, fire alarm and security lighting. A fire hydrant is positioned on the ground floor near the vigil. The amphitheatre is equipped with a mechanical smoke extraction system, activated by a centralised unit.
• Telecommunication: the entire building is equipped with a wi-fi network, in addition to cable networks for the teachers’ offices, computer lab and amphitheatre. The server room is in the control room, for security reasons.

• Lightning arrester and lightning rod: the building is equipped according to international standards, approved by the quality control firm.

• Plumbing: pipe networks are embedded in between masonry walls and are composed of high-density crosslinked polyethylene (PER). The bathroom is equipped with a 12-cubic-metre reservoir to ensure a supply for 48 hours in case of power failure.

• Ventilation: all wet rooms are equipped with mechanical fans.

D. **Origin of**

1. **Technology**

   European (Spain, France and Portugal) and Senegalese.

2. **Materials**

   Only cement, gravel, sand, basalt stone for the basins, wood for the formwork, and the moulds for the breezeblocks are from Senegal. All the rest is imported from Europe.

3. **Labour force**

   180 workers on average (not counting those of the subcontractors): 40 masons, 30 formers, 15 scrap dealers, 60 labourers, 12 guards, etc.

   Sub-contracted companies: electricity, plumbing and sanitary, frame, telecom, tiling, fire, air-conditioning, joinery.

4. **Professionals:**

   Main architects (IDOM):
   - Federico Pardos (Project lead, partner IDOM)
   - Javier Pérez (Partner IDOM)
   - Project architect, consultants co-ordinator (IDOM):
     - Beatriz San Salvador
   - Sustainability architect (IDOM):
     - Blas Beristain
   - Junior architects (IDOM):
     - Alejandro López (IDOM) – construction administration
     - Hugo Prades Claessens (ex-IDOM) – site analysis and design phases
   - Construction administration (IDOM):
     - Federico Pardos, construction manager
     - Papa Djibril Kane, civil engineer (CA phase)
     - Fally Diop, civil engineer (CA phase)
- Value engineer, main team (IDOM):
  Ana Robles
- Value engineer, supporting team (IDOM):
  Joseba Andoni Aguirre
  Sergio Llamosas
  Jorge Lorés (ex-IDOM)
  Juan Dávila
- Main draughtsman (IDOM):
  Iñaki Zabala
- Draughtsmen, supporting team (IDOM):
  Carlos Olmedillas
  Imanol Eizmendi
  José Ramón Lopez
  Rafael Anadón
  Ana Melú
- Specialised engineers, main team (IDOM):
  Arturo Cabo
  Francisco José Sánchez
- Specialised engineers, supporting team (IDOM):
  Luis Gonzalez
  Fernando José Catalán
  Javier Fernández
- Structural engineers, main team (IDOM):
  Miguel Angel Corcuera
  Fernando López
- Acoustics engineers (IDOM):
  Mario Torices
- Geologist (IDOM):
  Ignacio Olague
- Planner (IDOM):
  Juan Carlos Gómez
- 3D modelling (IDOM):
  Roberto Fernández
  Alfonso Alvarez
- Administrative team (IDOM):
  Clarisse Manuela Guiraud
  Dolores Pérez Brito
  Sonia Lopez

Architect of record:
- Cabinet d’Architecture Alioune Sow (CAAS)
  Alioune Sow

Local engineers:
- Subcontractor of CAAS
  Engineer
  Tandakha Ndiaye
Contractor:
- Compagnie Sahelienne d’Entreprises (CSE)
- Samba Diop (construction supervision lead)
  Mamadou Gaye (technical director)
  Moustapha Keinde (assistant of the technical director)
  Abdoulaye Kane (construction site overall director)
  Abdou Ndiaye (construction work lead)

Consultants:
- Quality Control Engineer
  Alpages
- Bruno Derenerville (Director, Alpages)
  Charles Antoine Sambou (project lead)
  Nourou Gueye (technician – construction site supervision; ex-Alpages)
  Mansour Sylla (technician – construction site supervision; ex-Alpages)
  Baye Sam Faye (technician – building services)
  Mounirou Fall (technician – structure)
  Jean François Faye (geologist)
  Boubacar Keita (geologist)
  N’déné Ndiaye (head of the supervision of construction techniques)
  Maley Han (technician)
  Lamine Diouf (plumbing technician)

V. Construction schedule and costs

A. History of project design and implementation, with dates

RFQ submission (phase 1 of the competition): 2010
Submission of the design and cost estimate proposals (phase 1 of the competition): November 2011
Signature of the contract: November 2012
Site analysis submission: December 2012
Submission SD and DD phase: February 2013
Submission CD phase: March 2013
Submission of bidding package: June 2013
Submission of revised bidding package: September 2013
Start of construction: May 2015
End of construction: December 2017
Final reception of the building: December 2018

Summary:
RFQ/Contract: 9 months
Design: 20 months
Construction: 32 months
B. **Total costs and main sources of financing**

<table>
<thead>
<tr>
<th>Financing body</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Bank</td>
<td>4,015,626</td>
</tr>
<tr>
<td>Senegalese Government</td>
<td>2,677,084</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,692,710</strong></td>
</tr>
</tbody>
</table>

C. **Comparative costs (if relevant)**

<table>
<thead>
<tr>
<th>Comparative cost</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated cost (IDOM)</td>
<td>3,458,941</td>
</tr>
<tr>
<td>Bid received (lowest)</td>
<td>2,346,804</td>
</tr>
<tr>
<td>Bid received (highest)</td>
<td>6,948,403</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>4,662,056</strong></td>
</tr>
</tbody>
</table>

Note:
In Senegal, all imported materials have an additional 41% of import taxes added to their actual cost plus maritime transportation.

D. **Qualitative analysis of costs (per square metre, per unit, etc.)**

Given the fact that the project has several typologies of spaces (covered, non-covered, gardens and circulations), surfaces were harmonised in the following manner: 100% for interior spaces, 50% for covered gardens, 70% for covered outdoor circulation, and 50% for non-covered circulation.

With this approximation, the construction cost/m² for the building is: 954 USD/m²
The construction cost/m² for basin landscaping: 80 USD/m²

E. **Maintenance costs (heating, cooling, etc.)**

According to information provided by Sidy Camara, the Director of Environment of the University: “At the moment, there are no large expenses related to the maintenance of facilities or equipment in the new TRU building. For the maintenance and the security of the premises as well as the purchase of materials and products for maintenance, we spend on average between 1,711 USD and 2,053 USD per month. This amount covers the salaries of ten cleaning staff for one month, the salaries of eight security guards for one month and the full amount needed to purchase products and maintenance equipment for one month.”

If we deduct the salaries of the eight security guards who are estimated around 1,026 USD, since these are not part of the maintenance of the building per se, the overall maintenance cost of the new building is on average: 10,266 USD per year.

The cost of electricity consumption is not known since the public provider SENELEC has not yet billed the University.
F. Ongoing costs and “life performance” of building, in terms of materials, maintenance, etc.

The choice of materials aimed to achieve low maintenance, given the limited financial resources of the University and the difficulty of material supply to Bambey.

The floor covering, for example, consists of 30-millimetre-thick terrazzo tiles, a material composed of white cement of 42.5 R value, marble powder and various aggregates, resistant to light and water and able to withstand very high foot traffic (10 Mpa flexural strength and 8.6 KN at the breaking load).

The exterior coatings are rough plaster coated with white cement and require no maintenance.

The doors are made of laminated wood with high impact resistance and hence are very durable. The door frames are metal to prevent their degradation through impact and ensure the stability of the opening.

The railings are over-dimensioned to improve resistance to impact and deformation. Railings are composed of 50-by-5-millimetre iron rods, and a 100-by-10-millimetre flat iron handrail. In order to prevent rusting, all iron components were sandblasted, then covered with two layers of rust-proof varnish and two layers of resin-based paint.

The flying roof is made of double bituminous membrane reinforced by an inner frame made of polyester mesh. No element pierces this roof or is placed on it (such as chimneys, ducts, air-conditioning equipment, etc.) so as to limit its maintenance and therefore ensure its durability.

For suspended ceilings, the university has an additional stock of acoustic panels amounting to 10% of the laid surface.

The only necessary maintenance of materials is the following:
- air-conditioning equipment: filters
- light fixture replacement in case of damage or end of life
- interior painting (every 5 years)
- painting of railings (every 5 years)
- painting of doors (when necessary)
- glazing in case of breakage (when necessary)
- cleaning of the roof gutter from dead birds, leaves, etc. (every month)
- pump and plumbing elements (when necessary)
- wastewater treatment plant: weekly cleaning of the screen and annual sludge emptying.

A simplified maintenance chart was provided to the university specifying the items in need of maintenance, the frequency of inspections and the required number of staff. This table is part of the customised maintenance guide for this building.

VI. Technical assessment

A. Functional assessment (use)

Overall, the building appears to be functioning very well: as a brand-new facility with a distinctive style, good construction quality and high-end teaching facilities, it has become the pride of students and teaching staff alike.
The classrooms, labs, teachers’ offices and auditorium are all equipped with furniture, projectors etc. used extensively from morning to evening. I even attended a conference in the auditorium, and saw that the space is functional and well suited to large crowds.

Before and after classes, students hang out around the corridors, the stairs and the basin areas, taking selfies galore.

The siting of an external stair on the east side of the building, facing the existing campus, allows for a fluid use of the new building.

Some of the key functional issues of the TRU building are:

• The teachers’ offices were partitioned by the University after the building’s completion, since teachers did not want to share a common space, instead each preferring their own enclosed space.
• The toilets were not open yet to users because the wastewater treatment unit was not functional yet, since the quality control engineer had not approved it due to his not having been paid. Two weeks after my visit, I received a video as evidence of the official launch of the toilet and wastewater system.
• The lack of proper audio-visual equipment and large screen, which will be fitted when funds become available, render the auditorium space less functional.
• The total lack of benches prevents students from properly using not only the shaded outdoor spaces but also the filtration basins.
• The lack of shade around the filtration basins does not allow for their use throughout the day.
• The lack of ablution facilities inside the toilets, due to a World Bank regulation, is an issue for students who often pray five times a day. As a result, the taps meant for irrigating the gardens along the north façade corridor, or between the south façade double skin, are informally used for ablutions, causing damage to the paving and walls nearby.
• Security: for aesthetic reasons the windows were not fitted with metal security bars. In the near future the University might install them, ruining the original vision of the architect.
• Acoustics: inside the auditorium, the acoustic panels along the walls were painted green. The paint must certainly affect the acoustic quality inside the auditorium. Based on my experience, the acoustics when a lecturer was using a microphone were acceptable (yet not stunning.)

B. Climatic performance, lighting, natural and/or mechanical ventilation, sun control, insect control, acoustics, orientation, etc.; description of systems developed and utilised

Climatic performance
Based on the analysis done by the architects’ team the following recommendation were made.

Avoid overheating by:
• preventing solar radiation inside buildings (sunshades)
• high-ceilinged interior spaces, allowing for stratification of the air
• use of highly reflective exterior surfaces (white in colour)
• maximising natural lighting to minimise the use of fixtures.

Implement bioclimatic architectural systems to:
• maximise natural ventilation (cross ventilation)
• increase the presence of vegetation and water in and around patios and buildings
• raise the level of thermal inertia of buildings (high thermal inertia of façades and floors).
The final design of the TRU building addresses climatic needs in the following manners:

- Based on my interviews of users (students and teachers), the thermal comfort of the auditorium outperforms all other spaces on campus, and the classroom interiors are pleasant. Facing windows permit passive ventilation, while the flying roof allowing wind to pass through and placed 1.5 metres higher than the roof of the buildings, keeps solar radiation away. Similarly, the double-skin south façade and the large northern canopy limit solar gain significantly. However, from a large and techy office like IDOM, I would have expected to see thermal simulation done during the design phase to prove that precise calculations have led to the dimensioning of the double façade, the double roof and the decision not to place insulation on the building walls. Also, no temperature measurements have been made to know precisely the difference between inside and outside temperatures and to verify if the 25°C maximum the architect claims is indeed true.

- The teachers’ offices’ newly added partitions prevent passive ventilation. Yet the teachers I interviewed did not complain about excessive heat inside their offices, as they can use air-conditioning when the weather becomes too hot. So far the use of air-conditioning has been minimal.

- When fully occupied, the auditorium’s thermal comfort can be challenging: it can be achieved thanks to the ceiling fans (in the month of April it was sufficient). Fans with longer arms might have created a more efficient cooling sensation for users. I suspect that air-conditioning might be needed in the hottest months.

- The filtration basins landscape, which is heavily used by students as a lounging area, would have benefited from canopies for shading, while waiting for planted trees to mature.
• To make up for the fact that no metal security bars were placed on the windows, they were made to open at approximately 30 degrees, which might diminish the effect of passive ventilation.

• The use of a black basalt stone, although local, causes heat to be absorbed and radiated in the basins.

Natural and/or mechanical ventilation
The teachers’ offices and the auditorium are fitted with individual air-conditioning units, upon the University’s request. The architect claims that “perceived” indoor temperatures are always at or below 25°C simply with passive ventilation and ceiling fans.

Sun control
Both the double roof overhang on the north façade and the south façade’s free-standing lattice wall provide effective sun control.

C. Response to treatment of water and rainfall; discharge of water, and retention and release system(s), if any

Bambey has marked rainy and dry seasons, so the building was conceived to take advantage of the rainfall. A gutter placed along the flying roof’s southern edge (the lower end of its slope) guides rainwater down vertical pipes towards open stone channels, leading to the four filtration basins.

Both black and wastewater is channelled towards a treatment unit with activated sludge. After being treated, the water goes through a sand filter and is finally sent to one of the filtration basins. This station is cleverly hidden by screen walls that utilise the same perforated breezeblocks used in the south façade.

It would have been more cost-efficient in the long term to separate grey and black water and to make them undergo different treatments. Also, the filtered water existing in the treatment unit is sent to the lowest basin, while it would have been better to channel it to the highest basin. This way, it would have trickled down and been further filtered by all four stepped basins.

Currently, if there is excess wastewater or rain, water in the westernmost basin could spill onto the natural landscape instead of being used to irrigate the plants inside the basin.

However, the wastewater system used in the TRU is very innovative for Senegal, where septic tanks are used widely, causing a threat to the environment and water table. This system could not only serve as a model for other projects but also as a learning space for University students.

D. Environmental response, adaptation to the natural environment, adaptation to native flora and fauna

The TRU building seems very well suited to its arid environment, since it provides a cool oasis inside the campus, with numerous shaded outdoor spaces.

In addition, the project is sensitive to the local flora since it uses only local plants in its basins. Also, the architects started an endemic plant garden between the southern façade’s double skin, but a lack of maintenance killed it all.

Similarly, the ground-level corridor along the north façade is lined with a band of grasscrete (perforated concrete blocks) which were meant to hold plants.
The local fauna was not really taken into consideration. The involvement of a landscape architect would have benefited the project since an analysis of local species and species at risk living around the site could have helped fine-tune the ecosystem developed in and around the filtration basins.

E. Choice of materials, level of technology

The choice of local material and technology was intelligent and permitted an excellent implementation and construction quality:

- The cheap, easy-to-produce and ubiquitous breezeblocks were re-imagined with triangular openings thanks to a mould made specifically for the project. Four types of moulds were produced and the breezeblocks were then chopped with a handsaw when the need arose, like for the corners. The success of the seamless implementation of the 203-metre-long south façade with these breezeblocks rests on the quasi-military discipline of the construction team: several tests were undergone and training sessions held before moving on to repeating this newly acquired skill.

- The coating of the breezeblocks with projected white cement, even inside their triangular holes, was done entirely by hand using a small manual projecting machine. It made the most of the characteristics of local labour (not highly skilled), material and technology. The projected tinted cement gave the breezeblocks texture and rendered them similar to traditional earth-wall finishes. It was a clever way to re-invent a modern Senegalese tradition.

- The permanent presence of both a topographer dedicated to the project and the largest construction company in Senegal certainly helped improve the quality of construction compare to other Senegalese projects I visited. The southern lattice wall for instance is impressive in its precision and relentless linearity.

- The floor paving in seashell concrete and terrazzo are very common in Senegal, so their implementation was done beautifully at the TRU.

- Welding being widespread across Senegal, the truss supporting the flying roof was easy to create and to mount on site, in a workshop set up for the project.

- The architects imagined their project as a repetition of components so as to facilitate implementation during construction.

- The repetitive nature of not only the components of the TRU building along a grid, but also the technical skills required to implement them, lowered the rate of errors inherent in construction sites, especially in the developing world.

- All railings in the TRU are composed of four similar branch-like modules that repeat in a random manner.

- There are two I-beam column types in the north façade holding up the flying roof. They are simply mirrored and placed randomly to create an effect of diversity. The repetition of the same modules lowered the rate of error and improved quality here as well.
New materials
Sadly all materials aside from the concrete, sand, stone, seashell, cement and gravel were imported from Europe, adding 40% in import taxes to their cost (transportation cost not included).

Given the sheer scale of the building and the unusually generous budget available, importation of material and building systems seemed logical. It included: wooden doors and their frames; glass; fans; bathroom tiles; appliances; lighting fixtures; etc. It was a missed opportunity not to encourage local labour and skills: for instance, local carpenters could have produced doors or window frames. However, both the architect and the client wanted the warranty of European material. By doing so they did not support the local economy.

Similarly, the moulds to produce the perforated breezeblocks were kept by the large construction company. The labourers from Bambey that were hired during the construction period, and who then became employed after the building was completed, could have benefited from holding on to these moulds. It could have helped them start a new business, use their newly acquired skills and spread these new building systems.

New technology
The wastewater treatment unit is the only new technology introduced in the project.

F. Response to, and planning for, emergency situations, i.e. natural disasters, floods, winds, fires, earthquakes, etc.

Fire
The building follows European standards for fire protection: circulation cores are in the open and are located less than 25 metres from any door. A fire hydrant is placed near the auditorium, adjacent to the building’s security guard.

All of the metallic structure is coated with fire retardant.

Floods
In order to prevent floods from damaging the building’s ground floor, the building is raised by 50 centimetres from the surrounding landscape’s ground level. This change in elevation is subtly hidden from view by the creation of a gentle slope.

Earthquakes
The foundation was calculated to support earthquake loads. Originally, the Spanish engineers from IDOM proposed a more robust foundation system, leaving a space between the ground-floor slab and the earth. But the local contractor, his engineers and the client decided against it based on their local experience. The conflict lasted for six months. In the end, the latter solution was implemented: the ground-floor slab now rests directly onto the earth.

G. Ageing and maintenance problems
The building is only one year old so there were no significant ageing, maintenance or wear problems.

Minor problem noticed included:
• The outdoor taps, originally meant for the irrigation of the gardens (that do not exist today), are used daily by students to perform their ablutions prior to prayer. As a result, splashing and stagnating water damages the paving nearby as well as the walls. A gentle slope towards the drain might resolve this problem.
• The aluminium profiles used to hide the expansions joints are not very aesthetic and display some signs of wear.
• The masts of some fans in the classrooms are already deformed; the connection of the mast might not have been solid enough.
• Some of the suspended coloured fins on the underside of the flying roof are starting to deform a bit due to wind.
• Students tend to throw rubbish in the filtration basins, since there is a lack of rubbish bins.
• The green paint on the organic acoustics panels in the auditorium does not seem to be adhering very well in some areas.

H. Design features: massing and volume, articulation of spaces, integration into the site (topography and neighbouring buildings)

The imposing massing and volume of the building is aligned with the client and architects’ intention to create a memorable icon. Spaces are very well articulated and easily accessible, since there are sufficient stair cores evenly spaced across the length of the building.

The project took advantage of the fact of the site’s slope: the area where the building stands was filled in so as to elevate it and prevent water from heavy rainfall from entering its ground floor. The height difference was subtly mitigated by gentle slopes. The building is thus well integrated with its surroundings.

Despite its imposing massing and volume, the TRU fits well within the low-density campus, because it respects its existing grid and sits at a good distance from the other buildings. The only problem noticed is a new single-storey lab building which is located north-west of the TRU, and stands at less than 17 metres from it.

I. Impact of the project on the site, in terms of increased circulation or vehicular movement, changes required for infrastructure (particularly for projects in high-density areas), etc.

In the low-density campus, the TRU project did not cause any negative impact on circulation or on existing infrastructure.

J. Durability and long-term viability of the project

Great care was taken in developing the project with local maintenance constraints and sustainability in mind. For instance:
• Lighting fixtures and ceiling fans, although imported from Europe, are available widely in Senegal and thus can be replaced easily.
• The University was left with a stock of acoustic panels in case some need replacement in the future.
• Highly resistant floor paving, seashell concrete and terrazzo, were used for stairs and all interior and exterior spaces: local staff know very well how to take care of them.
• The railings across the TRU were constructed with additional resistance thanks to many vertical steel members in the shape of tree branches, so as to ensure their long-term sustainability.
• No equipment was placed on the flying roof since it is difficult to access and exposed to the weather. Instead, all equipment was placed on top of the actual roofs of the buildings so that no expensive ladders are necessary to access them for repair and maintenance. In addition, the air-conditioning units are placed along the edge of the buildings’ roofs facing the corridor. It is not particularly aesthetic, but accessing them is very easy this way.
Lighting fixtures were not placed in areas which were not accessible (such as the high end of the flying roof) so that light bulbs can be easily replaced when dead.

Open-ended tubes were integrated in slopes of the filtration basins in order to facilitate natural growth of plants.

A maintenance booklet was handed to the University by the architects.

K. Ease and appropriateness of furnishings; interior design and furnishing

Aside from the seats of the auditorium which were imported from Spain, furniture was not included in the project; it was purchased separately by the Ministry for Higher Education. The interior design was minimal in the classrooms and offices: it included laboratory benchtops covered with white ceramic tiles.

VII. Users

A. Description of those who use or benefit from the project (e.g. income level, socio-cultural profile, etc.)

The users of the buildings are students, teachers, University administrative staff, and maintenance and security staff.

The students come from right across Senegal, the University being one of the top three in the country. In general, they come from a low socio-economic background, as the middle-class and wealthy students would usually attend university in Dakar.

The teachers and administrators are from middle-class backgrounds and they come from all parts of Senegal. They are well educated with university degrees.

The security and maintenance staff are from Bambey and its region. They are from low socio-economic backgrounds, and have a basic education level (secondary school).

B. Response to project by clients, users, community, etc.

Based on interviews, the University administrative team, including the Dean, is very happy with the project. They are proud of its high-end facilities and pleasant outdoor spaces, and delighted with the image of progress it infuses on campus and beyond. They find the building easy to maintain but wish for solar panels to reduce the electricity bill.

The students and teachers love the thermal comfort of the classrooms, and their modern facilities (ceiling fans, projectors, internet connection, plugs for their computers, individual desks, etc.). They also enjoy the fact that the classrooms are airy, well lit and can accommodate large groups without feeling crowded. The new auditorium was a much-needed replacement for the old auditorium which is literally falling apart with mould in its ceiling panels, panels falling down, leaking roof, broken seats, lack of ventilation, etc.

Students also wished for more rubbish bins, for ablution facilities in the toilets, for the toilets to be finally operational and for some air-conditioning units to start working (I am not clear why some are not functional yet). Students using the building have to go to their dorm room if they wish to use the bathroom.
Students are happy to be able to see their teachers in a proper office; before, they had to meet under a tree or in a corridor.

Teachers are very happy to finally have offices. However, they asked for them to be separated as they did not like sharing a common space. An actual office space facilitates their research work as well as encounters and exchanges with their students.

Interviewed students and teachers state that the building infuses a sense of “luxury” and “western feel” into their campus.

Overall, the teaching and learning conditions are viewed as excellent and inspiring.

The outdoor spaces, including the shaded areas like the stairs, the spaces between the southern double-skin façade and the filtration basins, are ideal spaces to hang out, study and review course notes. The students complain of the lack of benches in all these spaces and the lack of shade around the filtration basins. They also hope for more vegetation/gardens to be added as originally planned in between the double skin or along the ground-floor corridor on the north façade.

The maintenance staff interviewed were in awe of the building: they called it a “jewel that needs protection”. They said that it was easier to maintain than other buildings on campus that are falling apart. Their interventions are minimal. The staff were happy that this new building created new security and maintenance jobs for the community. It was not clear why the gardens were not properly maintained, causing the death of the plants.

They noted that they needed larger rubbish bins since the current ones tend to overflow, making their job harder. Also, in the classrooms, the plugs located on the ground can be a hazard when they are cleaning using water. They need to be extra careful.

1. **What do architectural professionals and the cultural “intelligentsia” think about the project?**

Local professionals I met were pleased with the project which elevates the construction quality in Senegal to new heights. However, they felt that the budget provided by both the World Bank and the Ministry for Higher Education was unusually large, making the building an exception and not confronting the constraints they all have to face.

2. **What is the popular reaction to the project?**

The popular reaction is very positive: everyone I met on campus was proud and delighted by the final result.

3. **What do neighbours and those in the immediate vicinity think about the project?**

The building being in a gated campus, the immediate neighbours are students living in dorms, and they all seem pleased by the building.
VIII. Persons involved

A. Identification of project personnel and their roles in the project (e.g. client, architect, planner, consultant, craftsmen, etc.)

Main architects (IDOM):
- Federico Pardos (Project lead, partner IDOM)
- Javier Pérez (Partner IDOM)
- Project architect, consultants coordinator (IDOM):
  Beatriz San Salvador
- Sustainability architect (IDOM):
  Blas Beristain
- Junior architects (IDOM):
  Alejandro López (IDOM) – construction administration
  Hugo Prades Claessens (ex-IDOM) – site analysis and design phases
- Construction administration (IDOM):
  Federico Pardos, construction manager
  Papa Djibril Kane, civil engineer (CA phase)
  Fally Diop, civil engineer (CA phase)
- Value engineer, main team (IDOM):
  Ana Robles
- Value engineer, supporting team (IDOM):
  Joseba Andoni Aguirre
  Sergio Llamosas
  Jorge Lorés (ex-IDOM)
  Juan Dávila
- Main draughtsman (IDOM):
  Iñaki Zabala
- Draughtsmen, supporting team (IDOM):
  Carlos Olmedillas
  Imanol Eizmendi
  José Ramón Lopez
  Rafael Anadón
  Ana Melús
- Specialised engineers, main team (IDOM):
  Arturo Cabo
  Francisco José Sánchez
- Specialised engineers, supporting team (IDOM):
  Luis Gonzalez
  Fernando José Catalán
  Javier Fernández
- Structural engineers, main team (IDOM):
  Miguel Angel Corcuera
  Fernando López
- Acoustics engineers (IDOM):
  Mario Torices
- Geologist (IDOM):
  Ignacio Olague
- Planner (IDOM): Juan Carlos Gómez
- 3D modelling (IDOM): Roberto Fernández Alfonso Alvarez
- Administrative team (IDOM): Clarisse Manuela Guiraud Dolores Pérez Brito Sonia Lopez

Architect of record:
- Cabinet d’Architecture Alioune Sow (CAAS)
- Alioune Sow

Local engineers:
- Subcontractor of CAAS
- Engineer
- Tandakha Ndiaye

Contractor:
- Compagnie Sahelienne d’Entreprises (CSE)
- Samba Diop (site manager lead)
  Mamadou Gaye (technical director)
  Moustapha Keinde (assistant of the technical director)
  Abdoulaye Kane (construction site overall director)
  Abdou Ndiaye (works engineer)
- Boundiassane Diop (assistant to the site manager)
  Fode Samake (assistant to the works engineer)
  Abdou Gueye Sarr (chief form setter)
  Thierno Niang (manoeuvering head)
  Cheikh Oumar (warehouse keeper)
  Saydou Nourou Gaye (quality manager)
  Mbacke Ndiaye (assistant to the warehouse keeper)
  Lamine Ba (head of mechanics)
  Elhadji Thiam (head of security)
  Pape Malick Thiam (machine operator)
  Modou Tioune (machine operator)
  Ahmed Ndione (doctor)
  Serigne Fall (air-conditioning technician)
  Cheikh Omar (electricity technician)
  Amadou Ba (plumbing technician)

Consultants:
- Quality Control Engineer
- Alpages
- Bruno Derneville (Director, Alpages)
  Charles Antoine Sambou (project lead)
  Nourou Gueye (technician – construction site supervision; ex-Alpages)
  Mansour Sylla (technician – construction site supervision; ex-Alpages)
Baye Sam Faye (technician – building services)
Mounirou Fall (technician – structure)
Jean François Faye (geologist)
Boubacar Keita (geologist)
Ndéné Ndiaye (head of the supervision of construction techniques)
Maley Han (technician)
Lamine Diouf (plumbing technician)

IX. Bibliography

A. List of publications

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TC Cuadernos
Arquimaster
Bau Netz
Archi.ru
Archdaily
Archiportale
Plataforma arquitectura
Plazatio
Arquitectura Viva online
Divisare
Le Soleil

Aziza Chouani
May 2019
Ground floor plan
Lecture building for a university, with capacity for 1,500 students, composed of a 500-seat amphitheatre, classrooms for 50 and 100 people, laboratories and technology rooms and offices for lecturers. All destined to training and research of applied sciences and ICT.
The roof is like a double skin supported by steel lattice beams: a metal sandwich panel with insulation on top, as a first barrier against heat and solar radiation, and a dropped ceiling of mineralised fibres on the inside, generating two layers with ventilation between them.
7.85 m free standing lattice wall compose the Southern facade, regularly pierced by entrance gates. The Eastern Façade, facing the existing campus, is also composed of a similar free standing lattice walls which are made of perforated cinderblocks, using local techniques.
To solve the lack of sewage and rainwater networks problem, a system of infiltration rafts with vegetation that collect rainwater was incorporated as a natural meander that is integrated into the landscape, favouring the natural development conditions of native vegetation.
The structure of the building’s roof was conceived as a big tree that shelters life underneath it and creates a cool multipurpose public space. The shape of the flying roof columns, which emulates a tree trunk and its branches, strongly marks the identity of the project as a whole.
Classrooms and laboratories are airy, well-lit and can accommodate for large groups without feeling crowded.

The amphitheater can accommodate 500-seats. Its walls are covered by 60 x 120 cm wood fiber panels painted and screwed onto a metal frame.
Inspired by a large tree in the centre of the Alioune Diop University campus, the new lecture building was designed as a place of shelter, shade and freshness for its students. Scarcity of resources conditioned the use of bioclimatic strategies: a large double roof canopy extending 10m over the north façade and latticework covering the south one prevent direct solar radiation while remaining permeable to air. To solve the lack of water and sewers, the architects incorporated infiltration rafts with vegetation that collect rainwater. Waste water is purified through an ecologically sound system that uses activated sludge. The simple yet ingenious building offers facilities for training and research in applied sciences and information and communications technology. It can accommodate up to 1,500 students in its large amphitheatre, differently sized classrooms, technology rooms and laboratories.
Lecture Building at the Alioune Diop University
Bambey, Senegal

Architect
IDOM
Bilbao, Spain

Client
Socé Diop Dione (ACBEP), Urbanism Ministry and Higher Education Ministry

Commission 2012
Design 2013 – 2014
Construction 2015 – 2017
Occupancy 2017

Site 12,000 m²
Ground Floor 8,490 m²
Total Floor 8,490 m²

Costs USD 3,300,000

Programme
This new lecture room block at the university comprises a 500-seat amphitheatre, classrooms for 50 or 100 students, laboratories and technology rooms, and offices for lecturers in the faculty of applied sciences and ICT. The building is a simple construction of concrete blocks cast on site, covered with mortar and steel latticework. It has a large double roof and a great lattice covering the south façade, which avoids direct solar radiation but remains permeable to air. To solve the lack of sewers and water supply issues, the architects incorporated infiltration rafts with vegetation that collect rainwater, and waste water is purified through an ecologically-sound system that uses activated sludge.

In Senegal, shade and water are everything. This project, a close relative of another in Gaston Berger, San Luis, which was commissioned by the Ministry of Education and the World Bank, aims to respond to this context as a perfect machine, beautiful in its efficiency and without an engine.

We developed the project from its cross-section, providing the building with a large double roof and a great lattice on the south façade, an L-shaped shield laying on its back, which avoids direct solar radiation but is permeable to air. This shield creates a Venturi effect generating a constant air flow between the building envelope and the lecture rooms, reducing the interior temperature by 10-15 °C degrees, a change from the outside 40-45 °C.

Building Type Cultural Facilities
2019 Award Cycle 5216 SEN

Authors
Javier Pérez Urbani
Federico Parido Aubier
The building is simple in its construction, appropriate to the possibilities of the place: concrete blocks built on site covered with mortar and steel latticework; repetitive, with only one type of window; long, creating a visual reference and hand-crafted – the manufacturing of the 20,000 blocks of the lattice gave employment to more than a hundred workers of Bambey for 6 months.

To solve the lack of sewage and rainwater networks problem, we incorporated infiltration rafts with vegetation that collect rainwater, as a natural meander that is integrated into the landscape, favouring the natural development conditions of native vegetation. A purification system by means of activated sludge allows the purification of waste waters, which, once purified, are discharged to the same rafts.
Alioune Diop University Teaching and Research Unit
Bambey, Senegal

Clients
Ministry of Urbanism, Senegal
Ministry of Higher Education, Senegal
Agence de Construction des Bâtiments et Édifices Publics (ACBEP), Dakar, Senegal
   Socé Diop Dione, director
   Moussa Sarr, project manager
   Gorgui Gueye, secretary-general
Ministère de l’Enseignement Supérieur et de la Recherche (MESR), Dakar, Senegal
   Mary Teuw Niane, former Minister of Higher Education
   Maguette Kebe Doumbouya, project director
Université Alioune Diop de Bambey (UADB), Bambey, Senegal
   Lamine Gueye, rector
   Matar Mour Seck, Abdoullah Cissé, former rectors
   Papa Ibrahima Faye, Senghane Mbodji, vice-rectors
   Sidy Camara, environmental manager
   Omar Diouf, domain manager
   Abdoulaye Mbow, former domain manager
Banque Mondiale (BM) / World Bank (WB), Dakar, Senegal
   Atou Seck, resident representative in Djibouti
   Séhoum Diouf, architect
   Mbaye Faye Mbengue, environmental expert

Architects
IDOM, Bilbao, Spain:
   Federico Pardos Auber, partner, project director and director of IDOM Senegal
   Javier Pérez Urribari, partner and project director
   Beatriz San Salvador, partner and project architect
Blas Beristain, sustainability architect manager
Ana Robles, main cost engineer
Iñaki Zabala, draughtsman manager
Joseba Andoni, cost engineer
Arturo Cabo, services engineer
Francisco-José Sanchez, services engineer manager
Fernando Lopez, Miguel Angel Corcuera, structural engineers
Mario Torices, acoustic engineer
Ignacio Olague, geologist
Juan-Carlos Gomez, planning engineer
Roberto Fernandez, Alfonso Alvares, 3D designers
Clarisse-Manuela Guiraud, administration management

IDOM SENEGAL SA, Dakar, Senegal
Fally Diop, Papa Djibril Kane, engineers and project supervisors

Consultants
Cabinet d’Architecture Alioune Sow (CAAS), Dakar, Senegal
Alioune Sow, architect
Optima Ingénierie, Dakar, Senegal
Tandakha Ndiaye, services engineer

Building Inspector
Alpages, Dakar, Senegal
Bruno d'Erneville, Charles Sambou Antoine, technical inspectors and managers
Nourou Gueye, Sylla Mansour, technical inspectors and on-site supervisors
Mounirou Fall, Baye Faye Sam, technical inspectors and engineers
Jean François Faye, Boubacar Keita, geologists
Ndéné Ndiaye, head of the supervision of technical construction
Maley Han, Lamine Diouf, technicians
Contractor
Compagnie Sahélienne d'Entreprises (CSE), Dakar, Senegal
  Samba Diop, technical construction director
  Mamadou Gaye, construction manager
  Moustapha Keindé, Abdoulaye Kane, Abdou Ndiaye, builders
  Abdoulaye Kane, construction site overall director
  Abdou Ndiaye, construction work lead

Project Data
Site area: 11,500 m²
Built area: 6,895 m²
Outdoor landscape (basins and rainwater canals): 4,316 m²
Cost: 6,700,000 USD
Commission: November 2012
Design: February 2013 – September 2013
Construction: May 2015 – December 2017
Occupancy: December 2017

IDOM
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