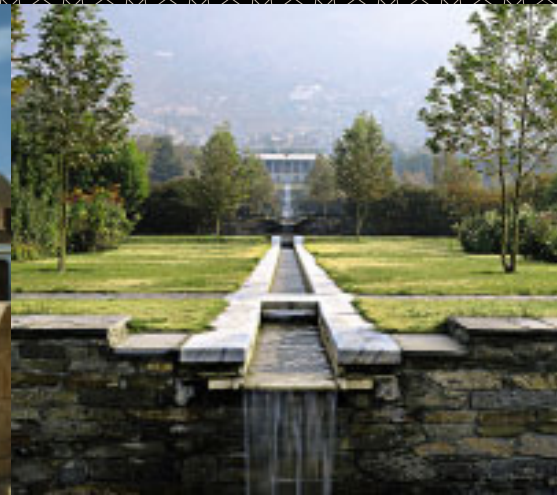
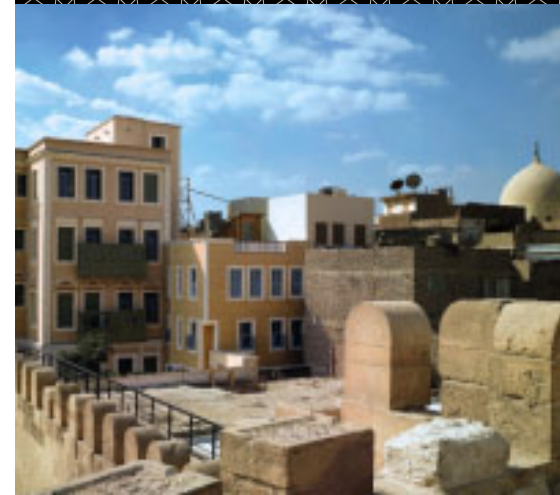
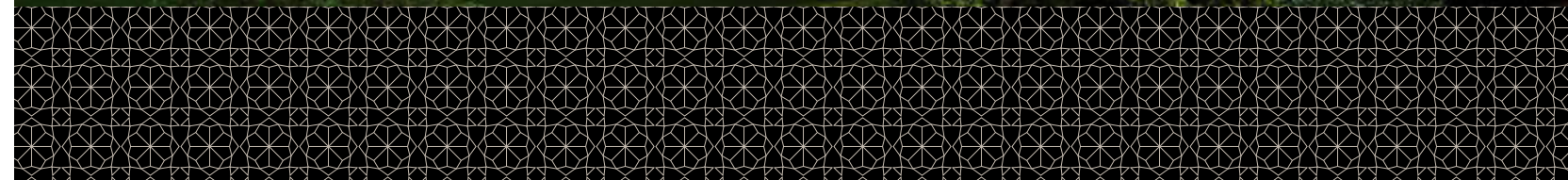


The Aga Khan Historic Cities Programme

STRATEGIES FOR
URBAN REGENERATION



EARTHEN ARCHITECTURE PROGRAMME

MALI





Programme Scope / Objectives

In restoring three major earth monuments, part of Mali's cultural patrimony, AKTC aimed to improve local capacity to manage architectural heritage, and sought to train people in the skills of building with earth. The hope was to pass on knowledge of restoration methods and appropriate technologies and materials to future generations.

Preceding pages:

In 2009, heavy rains caused the collapse of a portion of the south-eastern facade of the Great Mosque of Djenné.

Earthen Architecture Programme

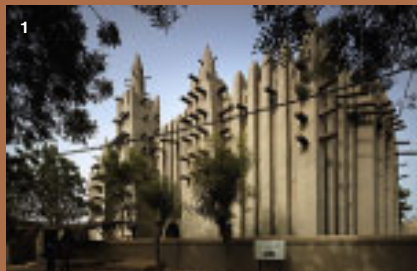
Much of what we know of Mali's past comes from oral histories passed down from one generation to the next by *griots*, or bards, whose profession is to memorize and recite events of the past. One of the first travellers to write an eyewitness account of Africa was Ibn Battuta travelling from Morocco to Mali in 1352. Since the late nineteenth century, archaeology provides us with clues of the past; we know that people lived in the region of present-day Mali as far back as a time when the Sahara Desert had abundant rainfall to support a lush forest, grasses and animals – long before it became a desert. In Djenné-Djeno, near present-day Djenné, there have been many archaeological finds despite a considerable amount of looting in the past. These finds indicate that Djenné-Djeno was inhabited as early as the third century BC. Urban life developed as early as the first century BC along the Inland Niger Delta (located between the Bani and Niger rivers in present-day south-western Mali) and for more than 2000 years it has been a crossroads of culture and trade and has seen the rise and fall of great empires.

Trade became an essential element in the rise and fall of the successive great West African empires of Ghana (Wagadu), Mali and Songhay. By about AD 300 camel caravan routes began to be established through West Africa and the Sahara Desert linking West African cities with Europe and the Middle East. Under the most famous of its emperors, Mansa Musa, Mali's influence expanded over the large city-states of Timbuktu, Gao and Djenné, which were all major trading cities along the trade routes, as well as cultural centres for the whole of West Africa. It was in these cities that vast libraries were built and *madrasas* (Islamic schools) were endowed.

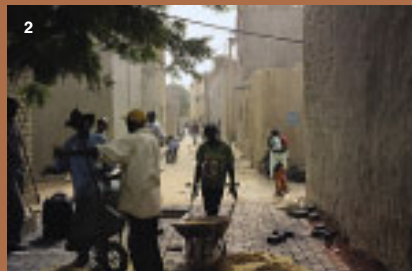
Little remains from the medieval grandeur in Timbuktu or Djenné except their congregational mosques, situated on the sites of earlier mosques, and some of the urban fabric in their cities. Constructed in mud, like the vast majority of Mali's building stock, the mosques of Mopti, Djenné and Timbuktu are among the world's largest and finest examples of earthen architecture and form an essential part of Mali's cultural heritage.

With these important landmarks of Mopti, Djenné and Timbuktu the Aga Khan Trust for Culture (AKTC) commenced the activities of its 'Earthen Architecture Programme'. The Trust strategy hinges on close cooperation with local institutions and stakeholders, and the direct participation of experienced local masons and

FEATURED CASE STUDIES



GREAT MOSQUE OF MOPTI



KOMOGUEL WATER AND SANITATION PROGRAMME, MOPTI



GREAT MOSQUE OF DJENNÉ



DJINGAREYBER MOSQUE, TIMBUKTU



Left, at Djingareyber Mosque *golettes* (pieces of wood placed between beams) are used for the roof of the Mosque.



Right, the *golettes* are being put into place.

specialists in restoration activities, ensuring a practical, hands-on approach and providing much needed training and job opportunities for local craftsmen.

The oldest mosque in the entire sub-Saharan region, the Djingareyber Mosque in Timbuktu, built in 1325, is still in use by the community. When the Trust commenced a survey and studies, the Mosque, made of tuff stone and mud subject to the depredations of a harsh arid climate, was in a process of advanced degradation due to deterioration of the mud plaster mix, associated with rainwater ingress into the stone and mud masonry and termite infestation of the timber beams; moreover, the accumulation of mud fill resulting from years of maintenance threatened to weaken the structure to the point of collapse.

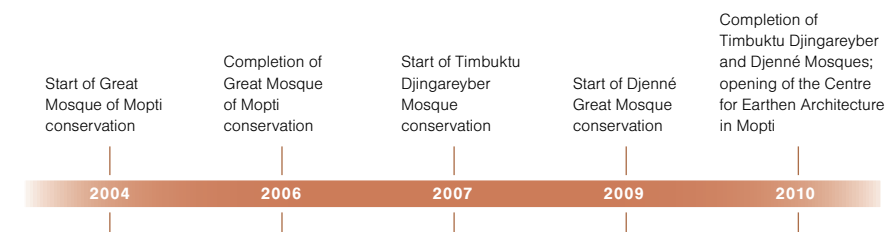
The Great Mosque of Djenné, constructed in 1906, lies in the core of the historic city on an elevated platform overlooking the city's main market square. Its construction technique is most unusual since it was built entirely of small cylindrical mud bricks called *djenne-fey*, a tradition that local masons grouped in a corporation called *barey-ton* are responsible for maintaining. As well as their technical skills, the traditional masons in Djenné hold magical powers, giving them social importance in the community. In spite of the yearly festival of *crépissage* during which the community replasters the facades of the Mosque, work by AKTC brought to light the poor inner structure of the walls and roof and proposed a comprehensive conservation plan.

The Great Mosque of Mopti, commonly called the Mosque of Komoguel, built between 1936 and 1943, was also in poor condition; it had been damaged by the inappropriate use of cement in a previous restoration effort in 1978. In an attempt to address further decay of the building, the community had applied a cement crust to the upper part of the walls, preventing the building from breathing and threatening to weaken the structure to the point of collapse.

Following the completion of the Great Mosque of Mopti, the Trust has implemented an infrastructure and habitat improvement programme that aims to raise the quality of the urban environment and the standard of living for residents in Komoguel. This programme involved the installation of an infrastructure network of water and sewage, street paving using blocks manufactured with recycled plastic bags, vocational training in building



Phasing 2004 → 2010



Heavy scaffolding covers the Great Mosque of Mopti in the early stages of its restoration in 2005.

crafts, the creation of a dyke to prevent annual flooding along the Pagué Danawal Lake and the creation of a community and visitor centre, public toilets and green open space for the public.

The 'Earthen Architecture Programme' has reversed the deterioration process and achieved the restoration of three important landmarks in Mopti, Djenné and Timbuktu, providing valuable experience in the technical, organizational and community-related aspects of preserving earthen structures in the country. Specifically it has succeeded in firstly identifying best practices of earth building grounded in local traditions and materials, introducing conservation methods and processes. In spite of the apparent vulnerability of earth architecture, the recourse to adequate mixes and organic additives, such as *karité* butter or baobab fruit powder, greatly improves the performance of traditional mud building. Secondly it has created a database of architectural, archaeological and technical documentation via first-hand knowledge of unique historic sites. Thirdly it has improved the local capacity to manage a precious architectural heritage, training locals in the skills of building with earth and reviving the traditions of handing down knowledge of restoration methods and materials to future generations. Finally it has generated economic benefits in terms of the development of local supplies, employment and tourism.

Great Mosque of Mopti

MOPTI, MALI

The Great Mosque of Mopti is an earthen structure built in the traditional Sudanese style between 1936 and 1943 on the site of an earlier mosque dating from 1908, and is commonly called the Mosque of Komoguel. At the time the Mosque was constructed, the Komoguel neighbourhood was in development as a result of the decision by the French settlers to use Mopti as Mali's central hub for trade along the Niger River.

When it became apparent, after preliminary studies and surveys, that the seventy-year-old Great Mosque of Mopti was in danger of collapsing, the Aga Khan Trust for Culture (AKTC) was asked to assist in its rehabilitation. Like other earthen buildings in Mali, the Great Mosque of Mopti had been maintained by the community with a traditional plaster of mud and rice chaff, but in recent years an incompatible layer of cement had been applied.

The first phase of the work on this important landmark focused on repairing the roof and stabilizing the upper part of the building, which had been damaged by the use of cement in 1978. Because cement adds additional loads to the structure and integrates poorly with the traditional materials, earthen buildings clad with cement often suffer water infiltration and structural damage over time – a process which, in this case, had weakened and seriously compromised the stability of the monument. Fissures in the cement cladding had been infiltrated by water, which had led to structural damage.

Preserving this unique landmark could only be guaranteed by the return to traditional earthen architecture techniques. Works included restoration of earth masonry, carpentry, roofing and technical installations; together with earthen plaster these aimed to re-establish its historical condition.

Starting in 2004, local masons worked to remove the cement layer and replace damaged areas with traditional mortar and bricks, which are made by mixing earth with rice. Roofing timbers and other structural and aesthetic elements made of wood were replaced. Then a fresh application of the traditional earthen plaster returned the building to its historic condition. To ensure that the Mosque remains structurally sound and that it is properly maintained well into the future, training courses were offered in traditional building crafts – skills that risked being forgotten in the region – and contemporary conservation methods



The Great Mosque serves the community of Komoguel in Mopti.

Opposite page:

Above, an aerial view of the Great Mosque after restoration.

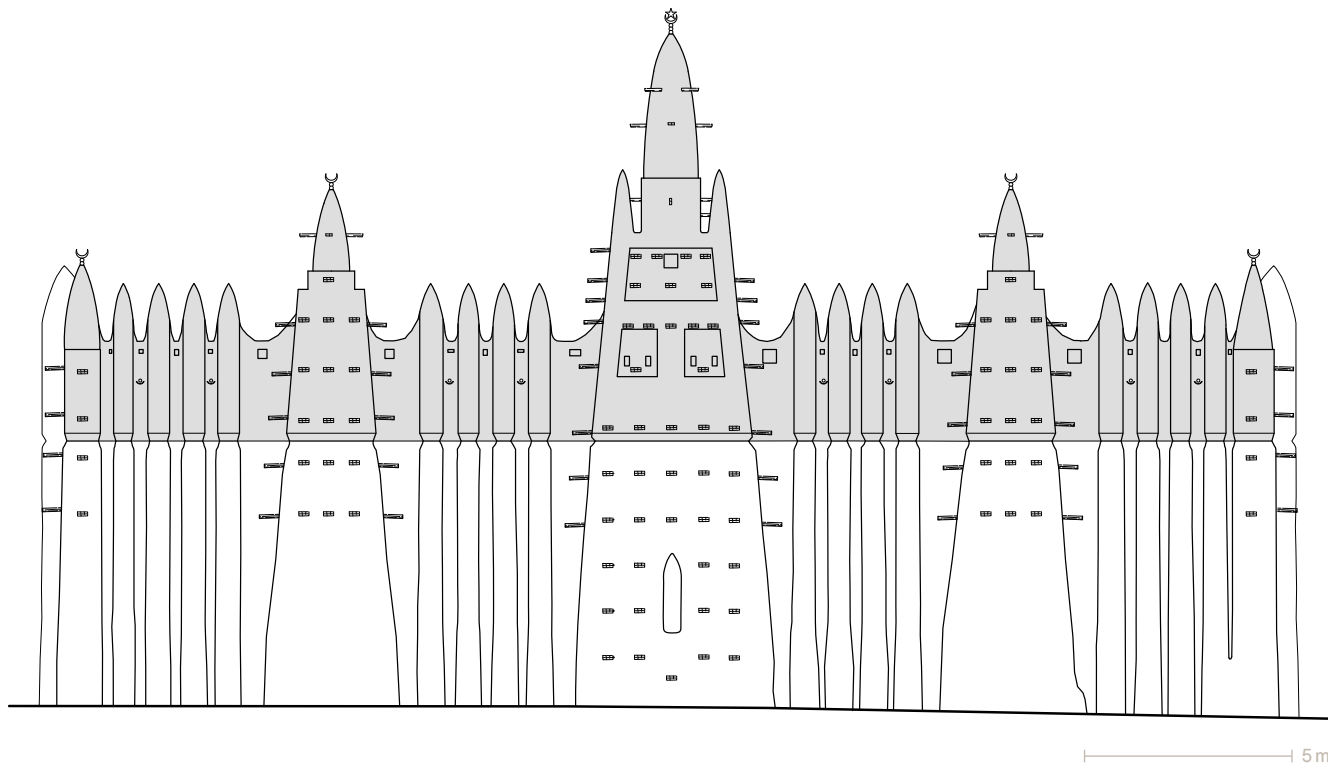
Below, workmen intent on removing the detrimental cement render on the roof.



Project Scope/Objectives

Works on the Great Mosque included the restoration of earth masonry, carpentry, roofing and technical installations, together with earthen plaster. The aim was to help to re-establish Mopti Mosque's original condition and historic status.





The Mosque elevation showing the cement render that had to be removed.

Opposite page:
The AKTC intervention has restored the elegant lines of the Mosque after they had been deformed by many years of refacing.

to more than sixty local masons and craftsmen. Literacy classes were provided to all implementation crew and foremen were trained in basic computer skills.

The Trust strategy hinged on close cooperation with local institutions and stakeholders, as well as on the direct participation of experienced local masons and specialists in restoration activities, thus ensuring a practical, hands-on approach and providing much needed training and job opportunities for locals. Efforts in Mopti have expanded to include a 'Water and Sanitation Programme', in the Komoguel district surrounding the Mosque, that aims to raise the standard of living for residents. In the process the Centre for Earthen Architecture, a community centre and public toilets were constructed.

The rehabilitation of the Great Mosque of Mopti has in many ways become a model for AKTC's other interventions in earthen architecture in Mali. Much of the knowledge gained during AKTC's two years of work in Mopti found its way into the 'Memorandum of Understanding' that was drawn up between AKTC and the Mali Ministry of Culture that paved the way for expanded restoration and conservation activity at other sites in the country. The work on the Mosque was conducted in conjunction with the Direction Nationale du Patrimoine du Ministère de la Culture du Mali, regional authorities, the City of Mopti and the Mosque's Committee. The local authorities also helped with the selection of experienced masons and young apprentices who are being trained on the job. The model was replicated at Djenné and Timbuktu. Training is an important aspect of AKTC's international work and mission. In 2006, following the Mosque's restoration, the site was included in the National Heritage List of Mali.



Background

BRIEF HISTORY OF PROJECT SITE
Mopti is one of Mali's larger cities, with a population of approximately 100,000. The Great Mosque of Mopti was built between 1936 and 1943 on the site of an earlier mosque dating to 1908. It is an earthen structure with similarities to the Great Mosque of Djenné. Komoguel neighbourhood, with its 10,000 residents, has developed around the Mosque since the beginning of the 20th century. In 2006, following Mopti Mosque's restoration, the site was included in the National Heritage List.

Challenges

SITE CONDITIONS
Preliminary studies performed in 2004 showed that the Mosque was subject to deterioration mainly due to the inappropriate application of cement plaster.

INFRASTRUCTURE
Mopti has no proper sanitation system and waste waters flow through its narrow streets before reaching the Bani River. Solid waste accumulates on the shores of the Bani River, forming a fill on top of which lives the poorest segment of the population. The district of

Komoguel, surrounded by Lake Danawal, likewise lacks all basic infrastructure services, and consequently suffers from related health and environmental hazards. Prior to the project, sewage water flowed down the middle of streets leading to Lake Danawal, which acted as a filtration basin.

BUILDING CONDITIONS
The Mosque's wall-bearing system was weakened by the application of a cement coat. The roof leaked owing to defective slopes and accumulation of earth fill.

Significant Issues and Impact

DATA COLLECTION/SURVEYS
The AKTC project performed the first architectural surveys of the Mosque in 2004, followed by a topographic survey of its surroundings.

PLANNING ISSUES
It was determined that the Mosque's preservation could only be guaranteed by a return to traditional earthen architecture techniques.

HISTORIC BUILDINGS/MONUMENTS CONSERVED
Conservation of the historic Mosque was the main objective of the AKTC project in the period 2004–06.

VOCATIONAL TRAINING/CAPACITY BUILDING
A group of 150 community masons and labourers was trained in earthen conservation methods, plumbing, carpentry and street paving.

CONTRACTING METHODS
Due to a lack of qualified contractors for monument conservation in Mali, the work was entirely in-house managed. This also enabled direct quality control, flexibility in the resources and on-the-job training.

Partners

PUBLIC PARTNERS
Ministry of Culture, Municipality of Mopti, Republic of Mali.

COMMUNITY PARTNERS
Comité de gestion de Komoguel.

Authoritative Framework

'Memorandum of Understanding' signed in 2004 between AKTC and the Ministry of Culture, providing the framework for an Earthen Architecture Programme in Mali.

Komoguel Water and Sanitation Programme

MOPTI, MALI

Situated at the junction of the Bani and Niger rivers, the city of Mopti in Central Mali has developed over the past one hundred years from a modest settlement into an important urban and administrative centre that reaches out to both the north and east of the country. In addition to its access to river traffic, the city is also well connected to Mali's road network. A twelve-kilometre causeway across an area of seasonally flooded agricultural land, which was constructed during the French colonial period, links Mopti with the national road network. More recently an international airport was added, which receives a fair number of foreign tourists whose main destinations are principally the Pays Dogon and the nearby historic city of Djenné.

Mopti's strategic location at the confluence of two major rivers has also become its major constraint to further development. During the months of November to February, when the waters of the Niger and Bani are at their highest levels, the city becomes a virtual island with only the causeway as its connection to firm ground. Mopti's population, currently estimated at more than 125,000, is squeezed during this period into an area of not more than 2.5 square kilometres. Not surprisingly, a parallel city has developed over the years at Sévaré, at the other end of the causeway, where there are no restrictions to growth.

As a result of population pressure and overall low levels of development, living conditions in Mopti, particularly in the areas around the harbour and in the adjacent districts of Komoguel and Gangal, have steeply declined over the past decades. Water and sanitation are in a very poor state, a situation that is being aggravated by the absence of a proper system for waste collection and by unpaved streets with open sewers.

The major objective of the intervention of the Historic Cities Programme (HCP) in Komoguel is to improve existing living standards in a limited geographical area of Mopti by focusing on improved health and sanitation conditions. In order to achieve this, a series of limited interventions aimed at improving existing sanitation conditions in an area confined to the immediate surroundings of the Great Mosque of Mopti have been implemented since June 2006.

HCP has based its intervention strategy on close cooperation with the inhabitants of the neighbourhood, local religious authorities and government



The streets are being paved with bricks made from recycled local refuse, such as plastic bags.

Opposite page:
The Centre for Earthen Architecture was inaugurated in 2010. The interior space includes exhibits interpreting the earthen architecture projects undertaken by AKTC.

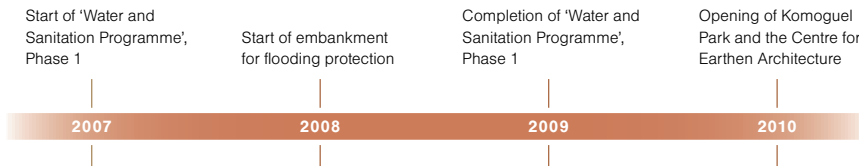


Project Scope/Objectives

This project's objective was to develop the built environment and improve local health standards through upgraded water supply, sanitation systems and street paving. This included the creation of toilet and shower facilities in a newly constructed community centre and the creation of the Centre for Earthen Architecture.



Phasing 2007 → 2010



Open sewers and poor drainage were serious health hazards in Komoguel.

Opposite page:
Successful efforts have been accomplished in Komoguel to improve the infrastructure. New paving has been made from recycled waste materials.

officials. Following the complete and successful rehabilitation of Mopti's Great Mosque by HCP in early 2006, substantial goodwill had been created with the local population and with the authorities to justify the launch of a major initiative for the area. The Mosque's Committee in particular welcomed plans for improvement of the environment in the immediate surroundings of the Great Mosque.

The activities are being carried out in phases. A first phase, which started in mid 2006 and continued until December 2009, focused on physical improvement of a relatively small area around the Great Mosque. In close collaboration with the local Mosque Committee, improvements have been realized to provide protection against periodically rising river water by constructing a flood barrier with 3200 square metres of landfill. In addition to this, several public water points were established to increase access to safe and clean drinking water; an underground sewerage system was established and connected with individual households; a treatment facility for raw sewerage was installed; 4000 square metres of streets were paved with locally manufactured bricks (made from recycled polythene bags and sand); and a system for collecting solid waste was introduced. These improvements made to the built environment during the three and a half years that it took to implement Phase 1 also generated training opportunities for 345 people in construction techniques, plumbing, masonry, brick manufacturing, carpentry and metalwork.

Following the completion of Phase 1, HCP commenced with the construction of public toilets, a community centre and a visitor centre on the landfill. The latter will house a permanent exhibition on earthen architecture and will also serve as a small museum, thereby generating income for the maintenance of the local water and sanitation system.

Based on information collected through an extensive baseline survey carried out during the first phase, a complementary second phase – involving also the Aga Khan Foundation (AKF) and the Aga Khan Agency for Microfinance (AKAM) – will follow, pending the availability of co-funding. The successful completion of the first phase for Komoguel has opened the possibility for further improvement of water and sanitation conditions in the quarter. During a second phase, a much larger area will be targeted for improvement. During Phase 2, two new sewage treatment facilities will be constructed, underground sewage will be put in place for 2000 beneficiaries and 8000 square metres of street will be paved with bricks. This second phase will include other socio-economic development issues related to public health, education, family income and possibly also open space development. During this phase cross-cutting issues such as gender, environment and the organizational and institutional development of civil society will also be addressed.



Background

BRIEF HISTORY OF PROJECT SITE

The district of Komoguel is located in north-east Mopti and borders the inner Lake Pagué Danawal. The project area encompasses Mopti's Great Mosque, built in the 1930s and now considered a prime example of quality earthen architecture in West Africa. The local built environment is semi-protected, with a limit placed on building height to protect the skyline.

Challenges

PROJECT RISKS

Water and sanitation development activities could continue through a number of phases to eventually encompass all watersheds in Mopti town, but local capacities to manage the complex of individual watersheds remain limited. With the island town's growing population and no further space for expansion, there is a risk of increased urban development along the town's outer edges, outside the established watersheds.

SITE CONDITIONS

Komoguel has one of the highest recorded residential densities in Mali (over 400 persons per hectare). Conservation and upgrading works faced significant logistical and technical challenges due to tight access via the narrow alleyways connecting fragile traditional homes.

INFRASTRUCTURE

The piped water network is insufficient. Untreated sewage, which currently is allowed to flow into inner Lake Pagué Danawal, poses a major health threat to the population. Acting as a large evaporation basin, the lake is in danger of disappearing altogether under layers of sediment made up of untreated sewage. Decades of under-investment in drainage, water supply and electrical networks, coupled with extensive war damage, means that significant investments are required to achieve the most basic levels of service coverage for a fast-growing population.

BUILDING CONDITIONS

Lack of maintenance, together with war-related damage, has left the bulk of Komoguel's traditional housing stock in a state of advanced disrepair. Additionally, high occupancy levels in subdivided homes pose a challenge to improving living conditions.

Significant Issues and Impact

DATA COLLECTION/SURVEYS

Since a first baseline survey in 2007, regular sample surveys have been conducted in the area and progress has been measured, covering more than 30,000 people. Nearly 40% of the population is 15 years old or less. Average household size is eight to nine people.

MASTER PLANNING PROCESS

A comprehensive master plan for Mopti is not available. There are remedial plans, however, for improving the port and some parts of the built environment.

PLANNING ISSUES

Mopti's relative isolation limits its future development. Ideally located for river traffic, it can only be reached by road via a single 11-km-long causeway passing through the floodplains to connect it with Sévaré. All future planning must take accessibility into account, balancing the needs of a relatively large population with a limited geographical space (around 2500 hectares).

COMMUNITY INVOLVEMENT/PROGRAMME

All sanitation improvement and construction activities were undertaken by or in close collaboration with community members. Community members are also assisting in managing and securing contributions to certain projects.

VOCATIONAL TRAINING/CAPACITY BUILDING

More than 300 craftsmen have been trained through apprenticeships during the course of the activities. Capacity building at organizational and institutional level involves the local counterpart CAK/Cogest (Comité d'Assainissement de Komoguel/Comité de Gestion).

CONTRACTING METHODS

All works were carried out with direct labour recruited (usually from the resident community) and supervised by AKTC professional staff. Subcontractors were used for moving earth (digging and transportation).

NEW TECHNOLOGIES INTRODUCED

Production of paving bricks manufactured from recycled plastic bags.

RELEVANT CODES/STANDARDS ADOPTED

All construction and installation work was undertaken in accordance with the relevant international charters and domestic laws.

Partners

PUBLIC PARTNERS

Ministry of Culture, Municipality of Mopti, Republic of Mali.

PRIVATE PARTNERS

Chambre des Métiers de Mopti.

COMMUNITY PARTNERS

Association pour l'assainissement de Komoguel.

Donors

Canadian International Development Agency, United States Department of Agriculture.

Authoritative Framework

'Memorandum of Understanding' with the Ministry of Culture (2006); various agreements with the Municipality of Mopti town.

Great Mosque of Djenné

DJENNÉ, MALI

Constructed by the community in 1906 on the remains of a pre-existing mosque, the Great Mosque of Djenné is the largest historical mud mosque in the sub-Saharan region and is considered by many to be the greatest achievement of the Sudano-Sahelian architectural style. It is located in the centre of Djenné alongside the marketplace, making it the city's focal social point. In 1988 the site was included in UNESCO's World Heritage List, together with the entire Old City.

Djenné is a small town of 13,000 inhabitants, located away from the main streams of development of Mali. The main income sources on which the local community is dependent are limited to the weekly marketplace and foreign tourism. While urban life is divided by neighbourhoods, the local community leaders play a major role in the city's decisions. The city has no proper sanitation system and waste waters flow in the middle of the tiny streets before reaching the Bani River, causing major environmental hazards. Solid waste is being accumulated on the shores of the river, forming a fill on top of which the poorest segment of the population has settled.

The Mosque has been preserved till now thanks to the yearly community effort of maintenance coordinated by the *barey-ton*, the local corporation of traditional masons, holding technical capacities in earthen architecture but also considered to have magical powers.

In spite of its yearly maintenance campaigns, the Mosque was in poor condition in terms of structural load-bearing walls and the roof. Based on a full documentation via topographic and architectural surveys, a damage assessment was drafted. The project scope was to guarantee the stability of the building by consolidating the carpentry and wall-bearing system. The Mosque interior was also subject to full conservation including rehabilitation of the Mosque's interior and exterior surfaces, eviction of the bats, and replacement of the defective sound, ventilation and lighting installations.

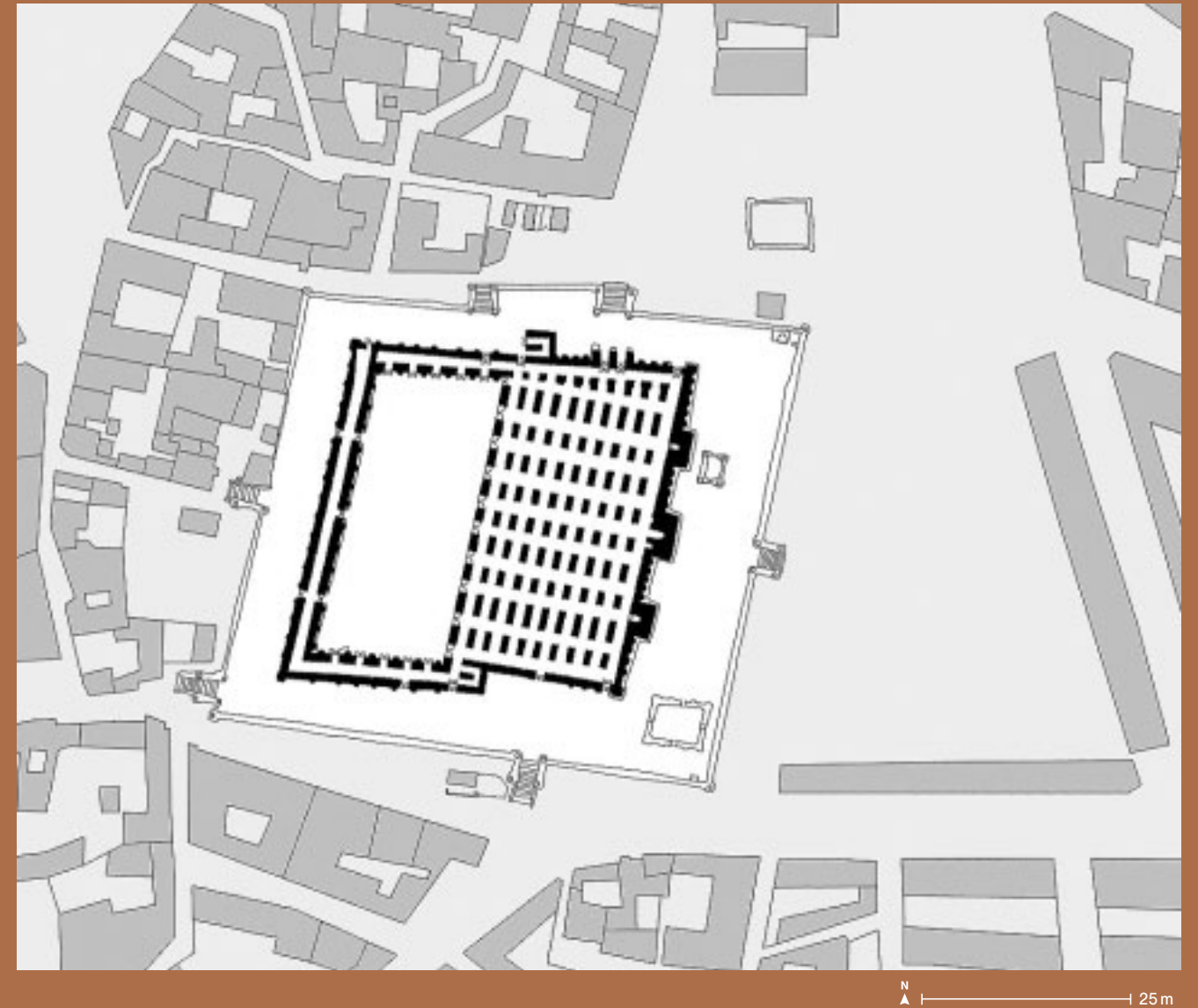
Due to a lack of qualified contractors for monument conservation in Djenné, the work was entirely in-house managed. This also enabled direct quality control, flexibility in resource allocation and on-the-job training in conservation methods to more than 120 community masons.



People are gathered for market day in Djenné with the Mosque in the background.

Opposite page:

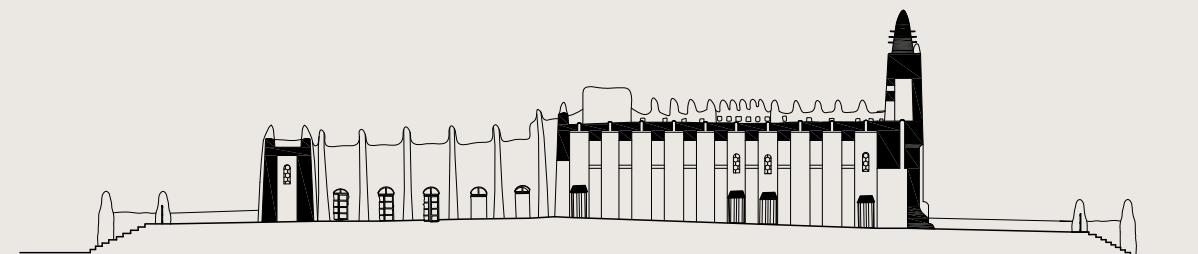
A view of the facade with an area for making *banco* to reface the Mosque in front of it.



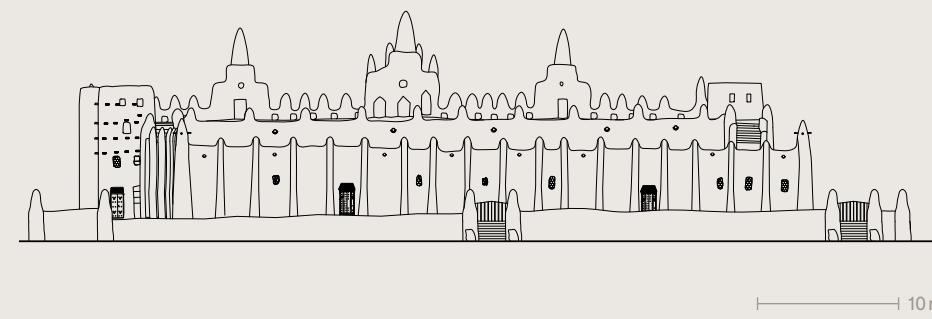
Project Scope/Objectives

This conservation project guaranteed Djenné Mosque's stability by consolidating carpentry and the wall-bearing system. The Mosque's interior and exterior surfaces were rehabilitated, and sound, ventilation and lighting systems installed.





Above, the north-south section of the Great Mosque in Djenné showing the main prayer hall and the courtyard.



Below: the west elevation of the Mosque.

Opposite page:
Minarets feature on this part of the east facade of the Great Mosque in Djenné, before restoration.

Background

BRIEF HISTORY OF PROJECT SITE

Djenné is a small town (13,000 inhabitants), remote from the main stream of development in Mali but well-known for the number of its *madrasas*, where young pupils receive a basic education grounded in Qur'anic reading. The main income sources are limited to the weekly marketplace and foreign tourism. Built by the community in 1906 on the remains of a pre-existing mosque, the Djenné Mosque is the largest historical mud-brick mosque in the sub-Saharan region. Its symmetrical layout and arches reflect European influence. The Mosque has been preserved thanks to the yearly community maintenance effort coordinated by the *barey-ton*. This local corporation of traditional masons have technical abilities but are also believed to possess magical powers. In 1988, the site was included in UNESCO's World Heritage List, together with the entire Old City.

Challenges

PROJECT RISKS

Urban life is divided by neighbourhoods, with local community leaders playing a major role in the town's decisions. Located in the heart of the town, the Mosque is a focal point, making its conservation a highly sensitive issue to Djenné residents.

INFRASTRUCTURE

Djenné lacks a proper sanitation system. Waste waters flow through its narrow streets before reaching the Bani River.

BUILDING CONDITIONS

The Mosque suffered from the weakened structure of the wall-bearing system; water ingress in the roofing due to defective slopes and accumulation of earth fill; and accumulation of earth plaster on walls, hiding architecture and filling windows and doors.

Significant Issues and Impact

DATA COLLECTION/SURVEYS

The AKTC project performed the first topographic and architectural surveys of the Mosque in 2008. Documentation of the work in progress is compiled on a regular basis and a set of as-built drawings is being prepared.

HISTORIC BUILDINGS/MONUMENTS CONSERVED

Conservation of the historic Mosque was the main objective of the AKTC project. Its interior area of 1400 m², as well as 800 m² of courtyard spaces was fully restored.

COMMUNITY INVOLVEMENT/PROGRAMME

The community and its leaders played an important role in the decision-making process of the conservation through regular information and discussion sessions.

VOCATIONAL TRAINING/CAPACITY BUILDING

Some 120 community masons and labourers were trained in earthen conservation methods. Literacy classes were offered to members of the implementation crew and foremen were trained in basic computer skills.

CONTRACTING METHODS

Due to a lack of qualified contractors for monument conservation in Mali, the work was entirely in-house managed. This enabled on-the-job training, direct quality control and flexible use of local resources.

NEW TECHNOLOGIES INTRODUCED

New sound, electrical and ventilation systems were installed in the Mosque's interior.

RELEVANT CODES/STANDARDS ADOPTED

Although there are currently no building codes applicable to earthen architecture, the project is in line with conservation principles drawn up by ICOMOS and calls on the best practice of earth architecture specialists.

Partners

PUBLIC PARTNERS

Ministry of Culture, Republic of Mali.

COMMUNITY PARTNERS

Comité de gestion de Djenné.

Authoritative Framework

'Memorandum of Understanding' signed in 2004 between AKTC and the Ministry of Culture, providing the framework for an Earthen Architecture Programme in Mali.

Djingareyber Mosque

TIMBUKTU, MALI

The Djingareyber Mosque is known to have been constructed in 1325 by the Andalusian architect Abou Ishak, at the initiative of King Hadj Moussa, upon his return from pilgrimage to Mecca. Since then the Mosque has experienced a number of modifications, resulting from the organic nature of earthen architecture and its vulnerability to weathering. Archaeological test pits carried out in 2009 in the main prayer hall have shown that at least three successive buildings have occupied the site. The main earthen ornaments on the *qibla* wall and some pillars may date back to the sixteenth century. In 1988 the site was included in UNESCO's World Heritage List, together with the city's other two historic mosques, Sidi Yahya and Sankore.

The Mosque is located at the southern edge of Timbuktu's historic city, forming the core of modern Timbuktu, the home of 30,000 inhabitants and capital city of Mali's Northern Province.

Lying at the meeting point between the Niger River Delta and the Sahara Desert, Timbuktu and the Sahelian environment is affected by growing desertification. Trees that used to form raw materials for the Mosque's carpentry are no longer available. Wind erosion and accumulation of sand deposits in the city's open spaces are also of concern for the integrity of the urban fabric and public open spaces.

Built in mud and tuff stone, Djingareyber Mosque was in poor condition when it was first documented by the Aga Khan Trust for Culture (AKTC) in early 2007: a full topographic and architectural survey, first performed on the Mosque, was the basis for a damage assessment. It revealed that the building was in weak structural condition, particularly the roof and wall-bearing systems, due to water ingress in the roofing. This occurred because of defective slopes and accumulation of earth fill and the mediocre quality of local mud plasters due to the decline of familiarity with traditional crafts.

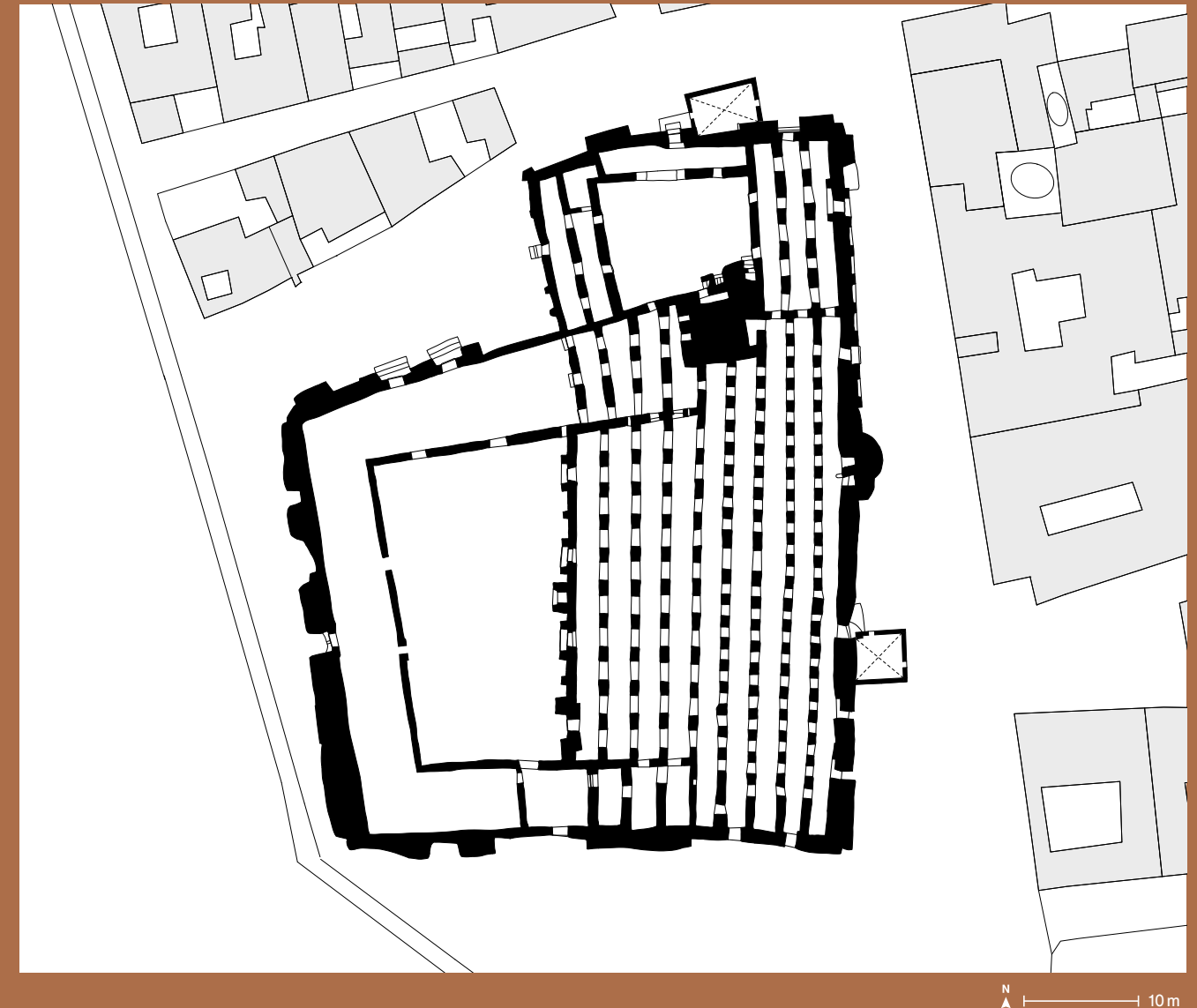
The project first focused on consolidating the mud masonry and carpentry, making the roofing watertight. Then the project aimed to conserve decorative earthen motifs and plastered surfaces in the interior spaces of the Mosque's covered prayer hall and replace the defective sound, ventilation and lighting installations.



The corner elevation of Djingareyber Mosque.

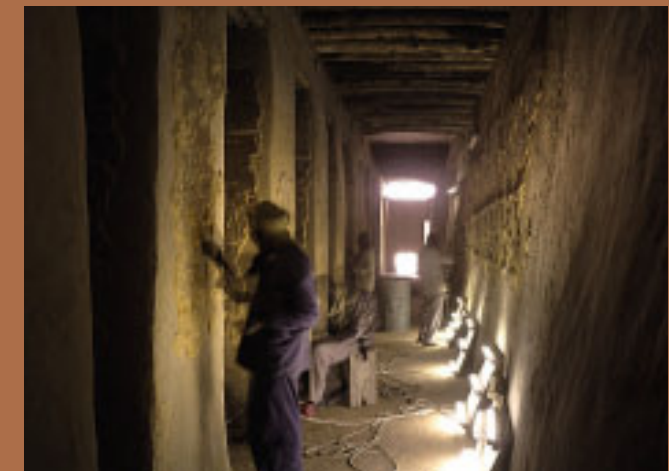
Opposite page:

Restoration work being done on the interior.



Project Scope/Objectives

Built in mud and tuff stone, Djingareyber Mosque was in poor condition before the intervention. The project focused on consolidating mud masonry and carpentry, making the roofing watertight, conserving decorative earthen motifs and plastered surfaces in the Mosque's interior, and also replacing the defective sound, ventilation and lighting systems.



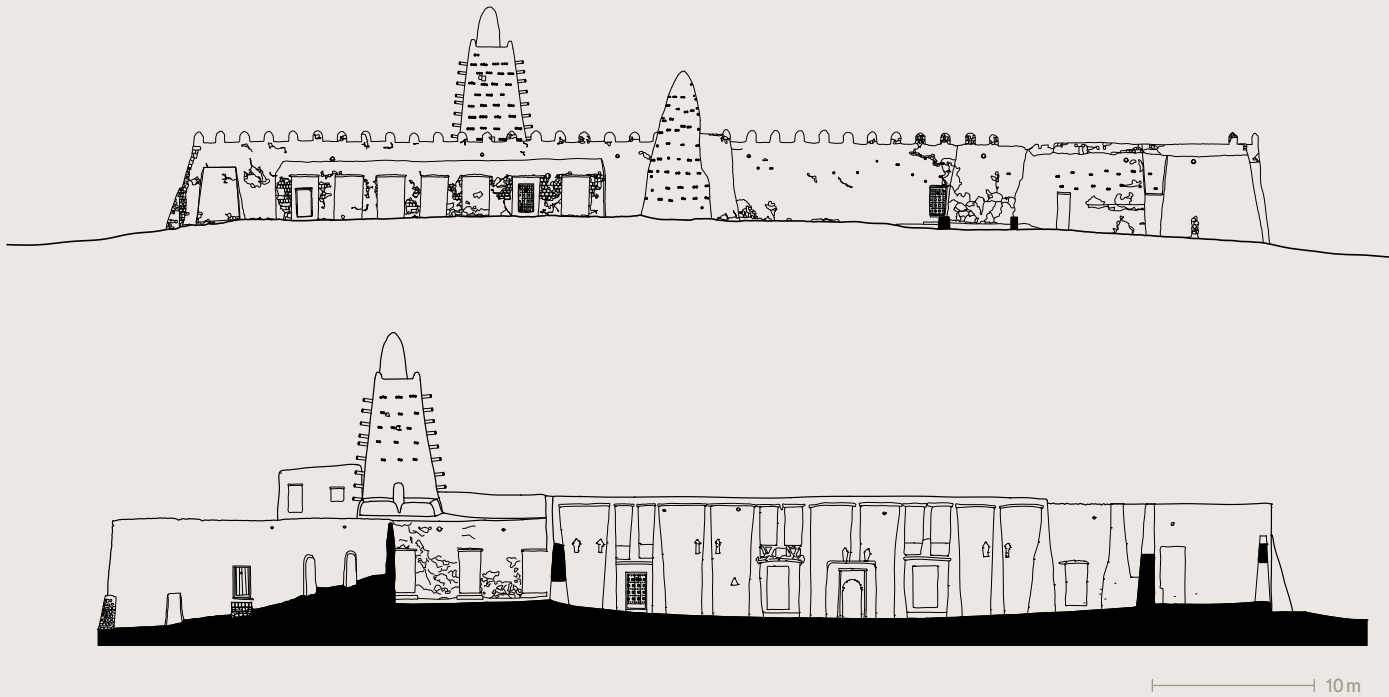


A minaret of Djingareyber Mosque after restoration. The Mosque was built in mud and tuff stone, evident in the foreground of the shot.

Opposite page:
The east elevation and longitudinal section of the Mosque.

Timbuktu is a remote location posing challenging logistical conditions. Sourcing quality construction materials in the immediate environment is difficult due to the decline of appropriate mud construction techniques. Logistics and local transportation, combined with the lack of skilled mid-level labour and security threats, are also challenging.

As a result, the work on Djingareyber Mosque was entirely in-house managed, employing traditional masons active in the neighbourhood's corporation. This mode of operations also enabled direct quality control, flexibility in resource allocation and on-the-job training in traditional building crafts and contemporary conservation methods to more than 140 community masons and craftsmen. Literacy classes were offered to all implementation crew and foremen as well as training in basic computer skills.



Background

BRIEF HISTORY OF PROJECT SITE
Timbuktu, a town with 30,000 inhabitants, is head of the Regional Council for the Northern Provinces of Mali. The population comprises a variety of ethnic groups, with a majority of Songhai, followed by Touaregs, Peuls, Bambaras and small proportions of other ethnic groups. Djingareyber Mosque was built in 1325 by King Hadj Moussa upon his return from a pilgrimage to Mecca, and has experienced a number of modifications over time. The main earthen ornaments on the *qibla* wall and some pillars may date to the 16th century. Archaeo-logical test pits carried out in the main prayer hall revealed that at least three previous buildings occupied the site. In 1988 the Mosque was included in UNESCO's World Heritage List.

Challenges

PROJECT RISKS
Timbuktu is remote. Sourcing quality construction materials, transportation and finding skilled labour can be a challenge. In recent years security has become an increasing concern too.

SITE CONDITIONS
Timbuktu lies at the crossroads between the Niger River Delta and the Sahara Desert, an area affected by growing desertification. Trees that once served as the raw materials for the Mosque's carpentry are no longer available. The organic nature of the Mosque's earthen architecture makes the building vulnerable to weathering elements. Wind erosion and accumulations of sand deposits in the city's open spaces are of concern for the safeguard of the Mosque and overall city fabric.

INFRASTRUCTURE
The systems of water and sanitation in Timbuktu Old City are based on infiltration pits and built on sandy soil, posing hygiene hazards.

BUILDING CONDITIONS
Djingareyber Mosque's structure is threatened by a weakened wall-bearing system, water ingress in the roofing due to defective slopes and accumulation of earth fill, and the mediocre quality of local mud plasters associated with the decline in usage of traditional building techniques.

Significant Issues and Impact

DATA COLLECTION/SURVEYS
The AKTC project performed the first topographic and architectural surveys of the Mosque in 2007. Documentation of the work in progress is regularly compiled to form the basis of a set of as-built drawings.

HISTORIC BUILDINGS/MONUMENTS CONSERVED
Conservation of the historic Mosque was the main objective of the AKTC project. An interior space of 2000 m², together with 800 m² of courtyard spaces, was fully restored. The roofing system was improved using tie beams to evenly distribute the roof loads (lime-based mortar and layers of mud insulation).

COMMUNITY INVOLVEMENT/PROGRAMME
The community and its leaders play an important role in the decision-making process of the conservation through regular information and discussion sessions.

VOCATIONAL TRAINING/CAPACITY BUILDING
A group of 100 community masons and labour was trained in extensive earthen conservation methods. Literacy classes were offered to all implementation crew and foremen were trained in basic computer skills.

CONTRACTING METHODS
Due to a lack of qualified contractors for monument conservation in Mali, the work was in-house managed. This enabled direct quality control, on-the-job training and flexible use of resources.

RELEVANT CODES/STANDARDS ADOPTED
Although there are currently no building codes applicable to earthen architecture, the project is in line with conservation principles drawn up by ICOMOS and calls on the best practice of earth architecture specialists.

Partners

PUBLIC PARTNERS
Ministry of Culture, Republic of Mali.

COMMUNITY PARTNERS
Comité de gestion de Tombouctou.

Authoritative Framework

'Memorandum of Understanding' signed in 2004 between AKTC and the Ministry of Culture, providing the framework for an Earthen Architecture Programme in Mali.

NATIONAL PARK OF MALI

MALI



National Park of Mali

BAMAKO, MALI

Bamako, the capital of the Republic of Mali, is located in the Niger River Valley. The city covers approximately forty square kilometres and it is estimated that its population has exceeded one million inhabitants. Since colonial times, Bamako has experienced significant population growth and this, in turn, has stimulated a constant growth of the urban area and demand for residential and public facilities.

The site defined and proposed for Bamako Urban Park lies within a larger protected forest reserve of 2100 hectares, a green belt of some magnitude and significance in this large but mainly arid country. The project site itself covers a total of 103 hectares comprising an inner active, cultural core zone of forty-nine hectares and an outer, more passive ecological buffer zone of fifty-four hectares. It is a large, semicircular canyon area that lies beneath the terraced outcrops of the Koulouba plateau between the National Museum and the Presidential Palace complex in a protected forest that remains in a relatively natural state. The central portion comprises the existing botanical garden, arboretum and zoo. The remainder is composed of the terraces and slopes beneath the 410-metre contour containing geological features such as caves, prehistoric habitats and an important range of flora and fauna.

The existing botanical garden, initiated in the 1930s, used to serve as a conservatory of local botanical species and a nursery for imported ones. A series of dams were constructed along the small riverbed to protect the area from devastating floods during the rainy season. The zoo, developed in a later stage, houses a number of African animals in cages. Small buildings were constructed throughout the period in the arboretum and zoo to accommodate maintenance staff and technical installations. What remains today of this earlier landscape are an arboretum affected by lack of irrigation with alignments of trees covered by alien vegetation, a dilapidated zoo and several small semi-neglected buildings.

Given its natural attractions, its large size and its location next to the museum complex, it was envisioned that the Park could become a large open space for leisure and educational activities, focused on the general public, school groups and tourists. The project brief called for the unification of the sites of the National Museum, the existing Botanical Garden and the Zoo into a single cultural/ ecological park of significant value, with natural and cultural attractions.



People relax and stroll along a pathway of the Park.

Opposite page:
Children making the most of the playground equipment.

Preceding pages:
A fountain attracts children on a path leading from the entrance to the National Park of Mali.



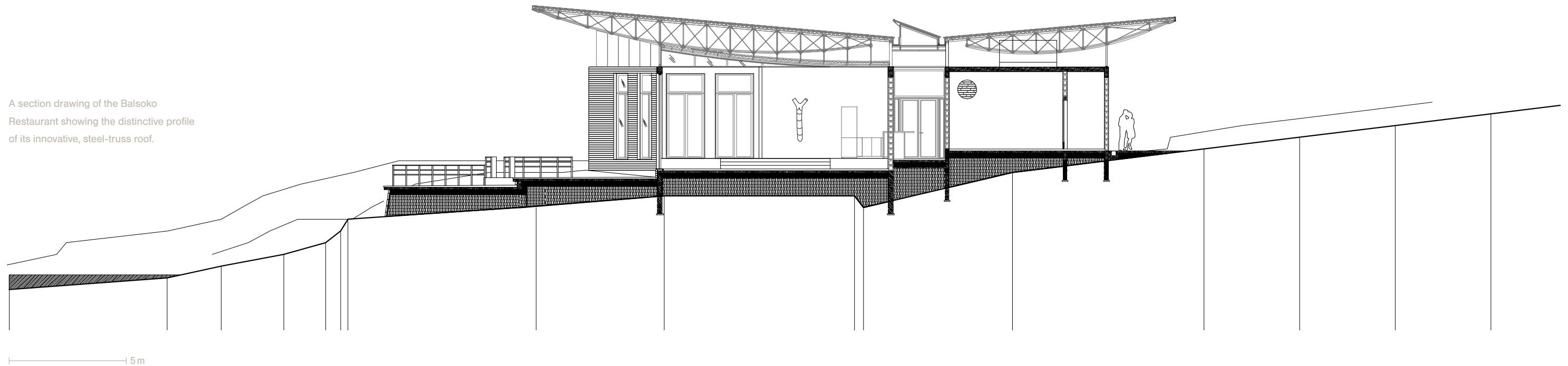
- | | | | |
|---------------------------|-----------------------|---------------------------|-------------------------|
| 1 National Museum of Mali | 4 Park Boutiques | 7 Children's Centre | 10 Freedom Entrance |
| 2 Parking | 5 Park Pavillon | 8 Tea-House | 11 Sports Centre |
| 3 Koulouba Entrance | 6 Balasoko Restaurant | 9 Medicinal Plants Garden | 12 Environmental Centre |

Project Scope/ Objectives

The Bamako Park project encompassed the creation of a high-quality, self-sustainable open space of 90 hectares allowing for cultural, sports, educational and family recreation activities. The scope of activities included a major site survey, hydrology study, detailed design of civil and electrical infrastructure, road and path works, landscaping and facilities design and construction. Reservoirs, a lake, pump stations, an effluent treatment plant for recycled water, the construction of perimeter fencing, and a range of new buildings were all created. New botanical elements include a medicinal garden, tree collections and extensive planting of indigenous plant species.



A section drawing of the Balsoko Restaurant showing the distinctive profile of its innovative, steel-truss roof.



Gardeners nurture seedlings at the Park nursery.

In 2008 the Aga Khan Trust for Culture (AKTC) developed detailed planning and a schematic design for Phase 1 of the project, while technical and economic feasibility studies were advanced for the totality of the proposed project. Phase 1 is seventeen hectares in area and contains a number of new building facilities, as well as rehabilitated open spaces and gardens.

There is a comprehensive pedestrian circulation network and formal promenades throughout the Park. The Park contains fitness, jogging, cycling and mountaineering tracks of varying difficulty and diverse interpretive awareness trails for botany, birds and nature. This pedestrian network provides easy access to the full extent of the 103 hectares of parkland and connects existing successful nodes, such as the National Museum, with other attractions, such as the amphitheatre dedicated to education or the performing arts.

An important part of Phase I planning includes the redevelopment and integration of approximately eight existing buildings, to be used for internal park operations, food and beverage points and storage. Built facilities, designed by Diébédou Francis Kéré, an Aga Khan Award for Architecture recipient in 2001, will include entry structures (a primary and secondary gate and entry building), a youth and sports centre cluster, a restaurant, public toilets and kiosks.

The garden spaces offer varied types of indigenous flora in different settings, from open lawn areas to flower gardens, wooded areas and a medicinal garden with explanatory signage. The installation of a range of interpretive educational material, in signage or display, and the potential for the development of trained guides could reveal a new depth of educational experiences to all visitors. By combining an environmental undertaking of a high standard with leisure and cultural facilities, all possibly under a public-private partnership approach, an important development model can be put in place in a favourable political context.



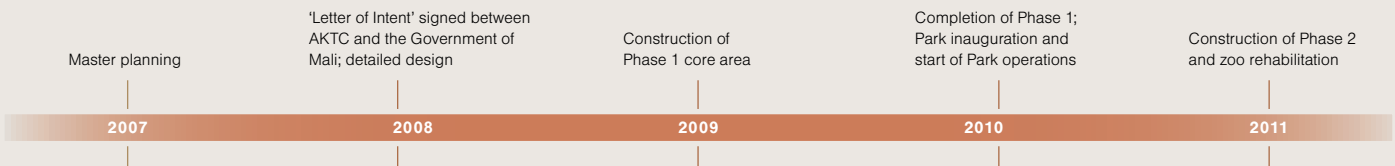
Park buildings, including the Balasoko Restaurant, in front of which there is a series of cascading water pools, were designed by the highly respected architect Diébédou Francis Kéré.





Opposite page:
The Maison du Thé in the Park is one of the existing buildings that has been restored and reused.

Phasing 2007 → 2013



Background

BRIEF HISTORY OF PROJECT SITE
The Park site is situated in a valley that during Mali's colonial era was designated as part of a 'storm-water mitigation' system. The site eventually became a formal Park, and subsequently a scientific estate with a zoo, botanical garden and the National Museum. A small road bisected the area separating the Park and Museum components. The seasonal watercourses crossing the site were dammed at intervals and stone foot-paths constructed to link various park features. Many indigenous trees were conserved, largely along the main stream, and formal, open lawns were set out between axial footpaths. Over time, poor maintenance and invasive trees and shrub species transformed the Park into overgrown thicket with insufficiently drained paths that became muddy in the rainy season. Since sports and family recreation are culturally important and the Bamako population lives in dense, often informal settlements, the Park nonetheless remained popular as a quiet shady refuge.

Challenges

PROJECT RISKS
Periods of extreme heat, interspersed with two intense rainy seasons, limit the window of opportunity for both construction and horticulture. The surrounding wooded slopes are subject to ad hoc burning to encourage grass for cattle, and such fires can spread uncontrolled. Informal collection of tree bark for medicine and wood for fuel threatened the mature trees on site.

SITE CONDITIONS
Virtually no formal facilities remained operational, including the original irrigation system. The planning process identified opportunities to reunite the Park and Museum through road closure and to restore, upgrade and enhance the natural facilities and activities offered by this dramatic valley site.

ENVIRONMENTAL CONCERNS
Water is a precious resource here and potential depletion of groundwater is an issue. Physical testing indicated that planned boreholes and water consumption were sustainable.

INFRASTRUCTURE
The municipal infrastructure did not have capacity for potable water, sewage treatment or irrigation requirements. Electricity supply was erratic.

BUILDING CONDITIONS
Access to building materials was limited due to the remoteness of the location.

Significant Issues and Impact

DATA COLLECTION/SURVEYS
The documentation prepared before the interventions included an evaluation of all site features: rock outcrops, specimen trees, boundary condition, various trail opportunities, offsite views, adjacent development proposals and catchment dynamics. Prototypes of construction materials and details were produced early in the planning process to inform design and define acceptable levels of workmanship. Engineering flood-line calculations were required to establish a no-build zone.

MASTER PLANNING PROCESS
A general programme was detailed, stating intervention priorities, integration of capital works and management objectives such as sustainability. This led to the preparation of area plans, descriptions of works, operational standards and budgets.

PLANNING ISSUES
Site works were programmed to take advantage of dry weather for building and infrastructure, and natural rains for plantings. Shift work enabled paving manufacture and construction to take best advantage of the seasons. Elements such as roofs and street furniture were prefabricated to expedite works and counter seasonal installation constraints. Natural stone was easily available and an on-site factory for cutting stone pavers and wall-facing blocks was established. These finishes served as a unifying theme. An autonomous water-related infrastructure was planned with bore holes, water treatment reservoirs, pumps and a package sewage treatment plant. Scour valves were installed in existing dams and new flood detention basins created. Standby electricity generators were also included in the infrastructure package. As long as the Park remained unfenced, informal public use continued. Completion of

the perimeter fencing was necessary to secure the site and ensure public safety. Grazing is excluded from the park area. Loss of mature trees was a consideration in the planning and the minimum number, largely alien species, were felled to assimilate the design. Many new plantings have been provided as an offset. The vast majority of required plant material was obtained from local sources or grown on site. Emphasis was placed on the proactive conservation of existing mature vegetation to preserve the Park's character. The Park's natural fabric – valley gorges, rock outcrops, woodland and riverine forests, and a rich birdlife habitat – was preserved and will now be protected and enhanced.

HISTORIC BUILDINGS/MONUMENTS CONSERVED
Administration and maintenance functions were dispersed at the Park edge. Several buildings were rehabilitated for new use as boutiques, a food kiosk, tea-house, crèche and environmental education centre. A range of buildings including formal entrance points, a gym and youth club, an environment centre, boutique, administration office, two cafés and ablution facilities were either erected or rehabilitated and the National Museum landscape was redesigned.

Partners

PUBLIC PARTNERS
Ministry of Culture, Ministry of Environment and Sanitation, Republic of Mali.

COMMUNITY PARTNERS
Associations of Park Users, Sports Club, Environmental Club.

Authoritative Framework

'Letter of Intent' signed in April 2008 between AKTC and the Government of Mali. A 'Public-Private Partnership Agreement' with the Government of Mali was signed in 2010.