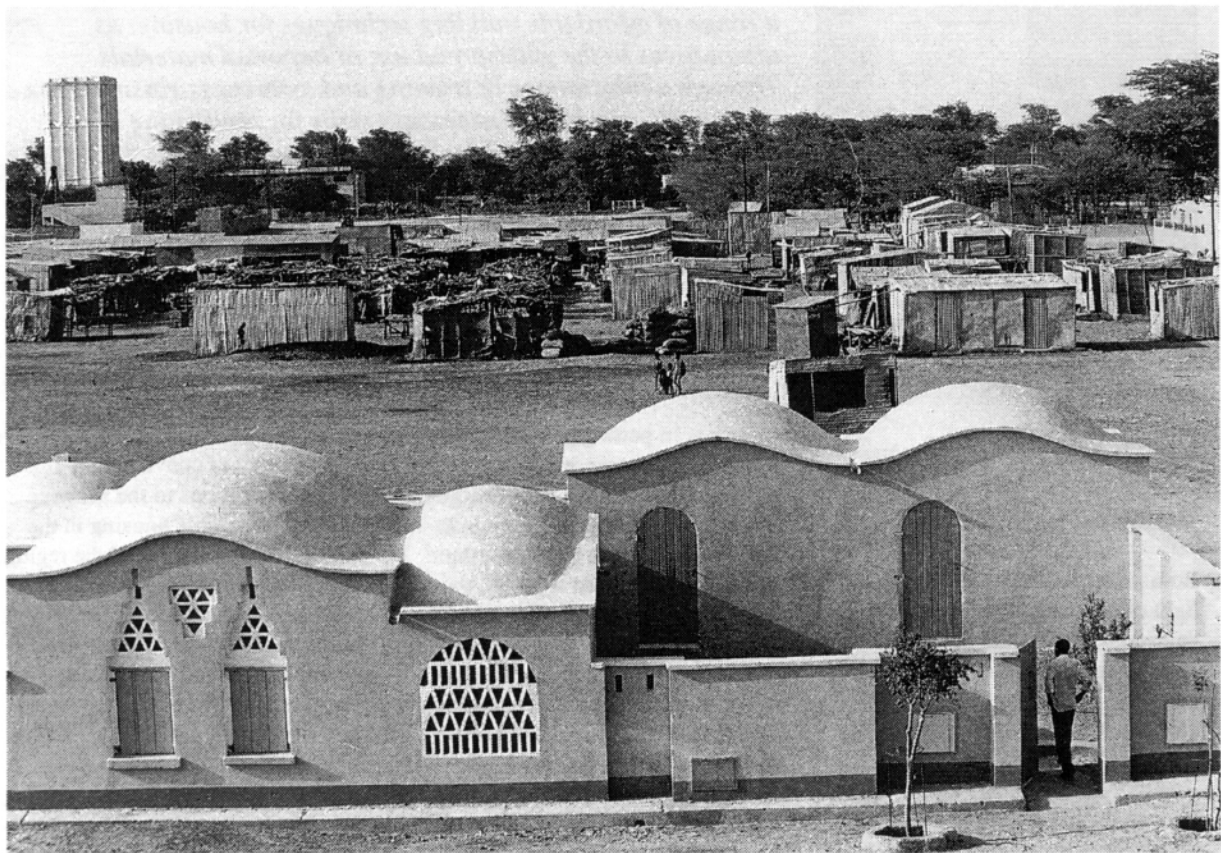




**1995 Technical Review
Summary**
by Jolyon Leslie

Rosso and Nouakchott Housing

Mauritania
245.MAU & 300.MAU



Architects

*Association pour le Développement
naturel d'une Architecture et
d'un Urbanisme Africain (ADAUA)*

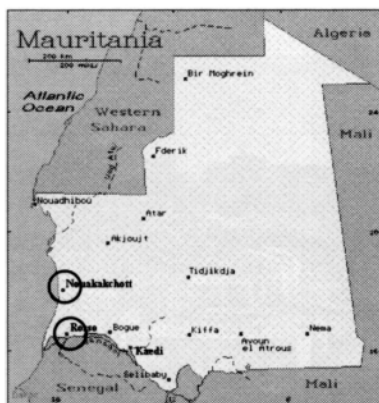
Client

*Ministry of Housing and
Société de Construction et de Gestion Immobilière
en Mauritanie (SOCOGIM)*

Completed

1983

The two projects aimed to provide examples of affordable housing for residents of informal settlements in the fast-growing urban environs of Rosso and Nouakchott, Mauritania. Together, the core projects comprised a total of 128 model homes and related buildings constructed between 1977 and 1983, together with a range of related upgrading and income-generating activities aimed at improving the living conditions of the urban population. The overall aim of the projects was to develop an "integrated" architecture, which would make maximum use of local resources and skills, while drawing upon the cultural context of the region. This was to be achieved by demonstrating a range of affordable building techniques for housing, as alternatives to the widespread use of imported materials. Through a programme of training and awareness-raising, the aim was also to provide the necessary skills for replicating appropriate techniques in self-built homes.



Rosso is located 180km South of the capital of Mauritania, Nouakchott

Context

Historical background

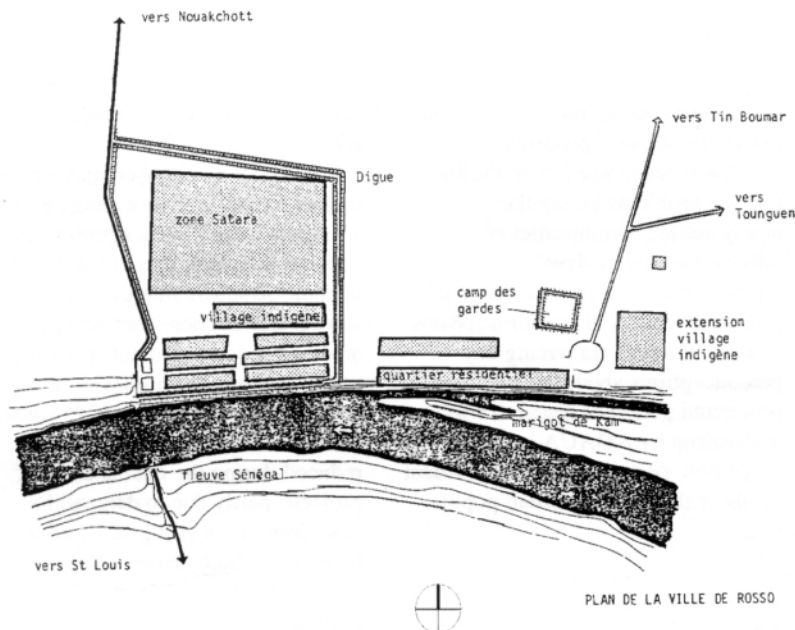
Both projects need to be seen in the light of the recent history of the built environment in Mauritania, where rapid urbanisation and long droughts have resulted in significant social changes for significant numbers of the population. Twice the size of France, Mauritania has a population of only some 2 million. In a society where three-quarters of the population were nomads 25 years ago, only 15% are now estimated to have a nomadic existence. The settlement of once-nomadic communities close to the urban centres, in the face of growing desertification of the areas they once depended upon for grazing, has put pressure on the fragile environment. Added to this, traditional systems of social hierarchy are being affected by these changes. In a country where slavery was only formally abolished in 1980, drought has proved more effective than legal

measures in putting paid labour into practice, as owners are no longer able to afford to keep their charges. Together with the former nomads, families descended from the ethnic group that was, until recently, the source of most slaves, now make up the bulk of the settlement around Nouakchott. In the case of Rosso, this process of migration has been aggravated by the economic activity generated by the border with Senegal.

In response to this situation, the Ministry of Housing, through the local Société de Construction et de Gestion Immobilière en Mauritanie (SOCOGIM) commissioned the pan-African non-governmental organisation, Association pour le Développement naturel d'une Architecture et d'un Urbanisme Africain (ADAUA) to promote appropriate self-built techniques of building, while exploring the traditional cultural heritage of the region. Under the auspices of FISA (Fédération Internationale de Synthèse Architecturale) ADAUA

set out to undertake a comprehensive re-evaluation of conventional technical solutions to the growing need for affordable housing in the context of Mauritania and the region. Part of the appraisal involved analysis of locally-available building materials, in a context where the continued import of components or raw materials was beyond the reach of most communities.

The project at Satara in Rosso provided the ADAUA team with an opportunity to explore the environmental and social conditions that influenced the growth of this and other informal settlements, as a means of formulating an appropriate response. To this end, a multi-disciplinary team worked between 1975 and 1977 on researching the environmental conditions, local skills, materials availability and socio-economic status of the newly-settled population. To some extent, the subsequent involvement in informal settlements on the outskirts of Nouakchott derived from the Rosso field work.



Site plan of Rosso, situated on the river, Senegal

and cultivated, allowing the desert to encroach.

Site

Both sites are typical of the informal sprawl around any fast-developing city, where the inhabitants make the most of the limited resources at hand to produce shelter. Densities are high, despite early attempts to limit the extent of construction on sites allocated under the projects, in order to provide each family with adequate outdoor space. It is reported that plot sizes were reduced by half by the local authorities in response to pressure for affordable land. In any event, most compounds seem to have been occupied by more than one family.

Given the informal nature of the settlement, investment in services or public facilities has been limited. Streets are largely sand, in many cases with open drains to dispose of domestic waste and rainwater. Public landscaping is non-existent, but some families tend trees or gardens inside their compounds.

Topography

In the case of the Satara zone to the North of Rosso, the site chosen for the demonstration of improved building techniques, comprising some 35 hectares, is low-lying and prone to flooding. Typical of many such sites, which had been cleared by settlers during the 1940's for cultivation, pressure on the land grew dramatically in the 1970's when nomadic farmers were forced to settle in such areas in the face of a devastating drought. The vulnerability of the site entailed considerable investment (both from residents and

Local architecture

The settlements where "improved" homes were built, on the outskirts of Nouakchott and Rosso, are characterised by a range of informally-built shelters, primarily of timber, reed mats or corrugated iron. Apart from being widely available and affordable, these components have the added advantage of being highly transportable, in the event of families moving their home. Originally nomadic, some of the population still has recourse to tents, which are erected inside walled compounds.

Traditionally, housing in the Rosso region, which is protected from the seasonal floods of the Senegal river, would have had pitched thatched roofs on timber structures with walls of sun-dried bricks. As in many other places, this style has given way in most towns to cement-block houses with pitched corrugated iron or thatched roofs.

Climate

The region is characterised by a desert climate, the extremes of which have limited settlement, and encouraged a nomadic lifestyle for much of the population. The proximity of the

ocean tempers the climate of Nouakchott, where temperatures range between 29 degrees C in the summer and 13 degrees C in the winter. Rosso is sited on the narrow strip (chemana) North of the Senegal River that comprises the only arable land in Mauritania. The entire area is affected by trade winds (alize), with seasonal cold winds (jefhya) blowing from the South in the winter, and hot winds (irifi) blowing from the North across the desert during the summer.

Climatic conditions are of immediate relevance to the patterns of settlement in Mauritania, given the rapid desertification and growth in population following the widespread settlement of nomadic communities around urban centres as a result of drought. Nouakchott, since its creation in 1960, has been engulfed by the sands of the Sahara desert as they creep along the oncostable Atlantic Coast strip. Partly as a result of the settlement of nomadic communities and the drilling of wells for water, livestock herds have grown and been concentrated in some areas, leading to overgrazing and environmental degradation. In addition, marginal lands that had been solely used for grazing have been cleared

from the project) in drainage measures, prior to and during the construction of the model buildings.

Programme

General objectives

The programme was formulated in the context of a growing awareness on the part of the Ministry of Housing and others to the problems of rapidly-expanding informal settlements around the urban centres of the country. This growth was primarily the result of a period of intense drought, which caused the loss of large areas of pastoral land that had traditionally supported nomadic communities in the hinterland of Mauritania. Their livelihoods having been adversely affected by the drought, these communities moved to urban centres in search of alternative sources of income. This in turn led to environmental problems in the peri-urban areas, as the new settlers put pressure on the scarce natural resources that existed, and therefore aggravated the desertification around the towns. There was a need to support these settlers in finding or developing a more sustainable way of living in their new, but fragile, environment.

The overall objectives were to develop an integrated package of measures that would both respond to the evident needs of the urbanising population of Mauritania, and draw upon the indigenous resources that existed among these communities.

The programme set out specifically to address urban poverty and economic dependence among once self-sufficient communities, by improving urban living conditions and encouraging investment in appropriate housing. In order to achieve this, the programme aimed to strengthen community participation, to introduce innovative technologies

and to promote the use of renewable resources where appropriate.

It was recognised from the start that the problems facing the newly-settled communities could only be tackled by developing an integrated approach to the range of physical, social and economic issues at hand. Rather than having any preconceptions about the solutions, a protracted period of research was undertaken by ADAUA in order to judge how best to address the evident needs of the growing urban population.

Description

Building data

The project at Satara in Rosso comprised a 35 hectare site, originally subdivided into 1,200 plots of varying sizes. Given that some public spaces were built on, the final number of plots is put at 1,773, providing homes for some 11,880

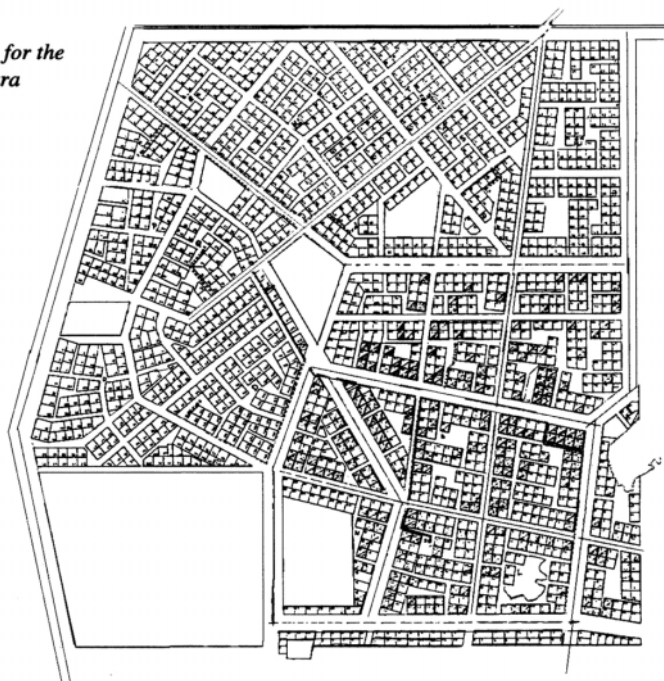
people, with an average family size of 6.7.

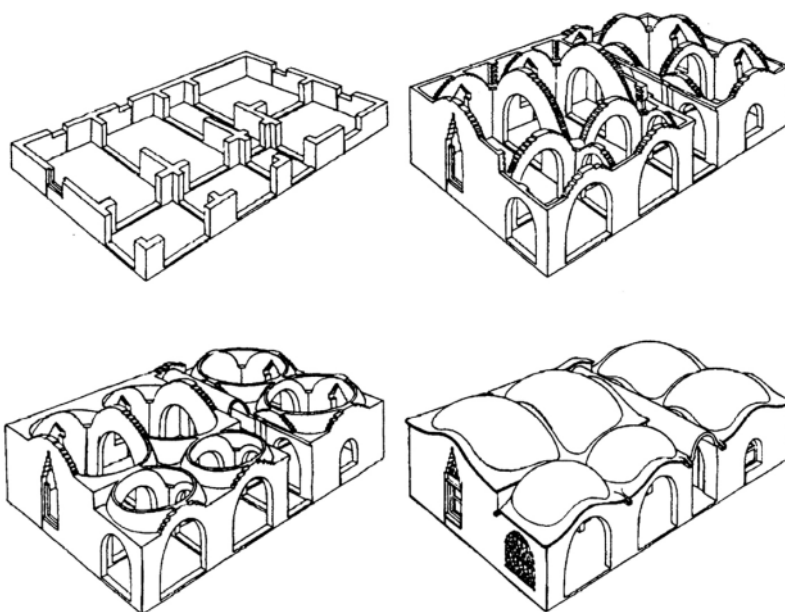
The pilot dwelling comprised two domed rooms, with an average area of 12 square metres each, opening via a covered verandah onto a courtyard of some 50 square metres. The WC, shower and kitchen were grouped around a secondary court of some 30 square metres. The homes were originally built on plots of 225 square metres, but these plot sizes were reduced during the course of the projects, partly due to demand for land. Initially, a group of 12 pilot houses was built around a large 1,500 square metre courtyard on individual plots of 180 square metres, to serve as a demonstration of the concept.

Design concepts

The design of the individual homes derived from a prolonged period of research into the technical and social potential for affordable housing in the context of informal settlements.

Housing lots for the zone of Satara





Various stages of construction for one of the original 12 demonstration units

cement-stabilised bricks, with some homes having roofs of plaster, cast on frames of bamboo bark. The geometry of the techniques was adapted according to the preferences of local builders.

The project consciously set out to make maximum use of materials that could be found locally or developed on site. This led to the use of:

- cement for concrete foundations and floor finishes;
- locally-fired or stabilised bricks for walls and domes/vaults;
- lime for internal and external finishes;
- gypsum plaster on bamboo frames for some roofs;
- timber windows and doors.

The construction technology developed under the projects was largely the result of the process of research and development conducted on site by the ADAUA team. This process aimed to develop and demonstrate a range of affordable alternative techniques for self-built housing.

With the exception of the 12 model homes in Rosso, few of the homes built under the projects enjoyed any on-site services. Three standpipes provided potable water for the population of the Rosso site,

but even at the time of their installation this was inadequate. The camels of the nomads have given way to donkeys drawing water-carts, which are the source of much of the water used in homes. There were plans to develop composting latrines (with support from UNICEF) as part of the Rosso project, but it is not known if these were ever built. Most homes have rudimentary external dry latrines, with separate facilities for ablutions. Drainage from the sites is provided by means of open channels, some of which were upgraded as part of the projects. The principal drain that was built through the Rosso project is now filled with waste and stagnant water.

Origins of:

Technology

The technology used for both projects derived partly from research undertaken on the site (in Rosso) and partly from external sources. While there is no tradition of dome-building in this part of Mauritania, a combination of models was chosen, on the understanding that these would best suit the local conditions. The sources

for the technology included the Nubian vault and dome (which was receiving widespread publicity at the time, due to the work of Hassan Fathy) and Iranian examples (which were also published at the same time). The synthesis of these techniques with methods that would use locally-available gypsum was the basis for the construction of the model houses and other structures to serve as demonstrations of the "improved" technology.

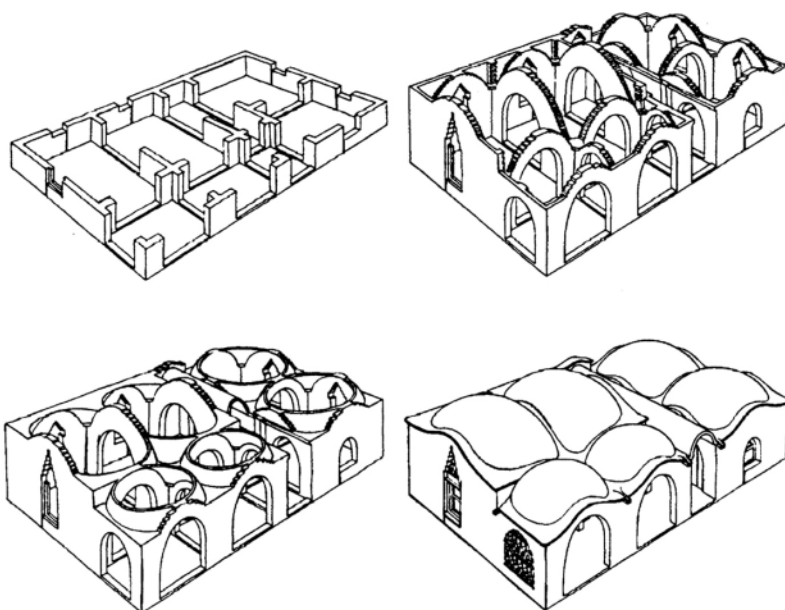
Materials

An important objective of the projects was the use of materials that were found or developed locally, in order to reduce the dependence on imports. To this end, sun-dried and stabilised bricks, made from earth extracted on site, were used for the structure. In addition, gypsum from a source close to Nouakchott was used for the structure, on bamboo frames, for some homes. In addition, lime fired from locally-collected seashells was used for wall finishes. Cement used for foundations and floor finishes was imported.

Labour force

The labour force for the construction of homes was entirely local, with some 35% having specialist skills. A community workshop was established in Rosso to train 30 masons in the techniques of the prototype dome and vault houses. A total of 80 masons were trained during both projects.

In addition, up to 500 residents were employed for labour-intensive upgrading works on the sites at different times. The development of



Various stages of construction for one of the original 12 demonstration units

cement-stabilised bricks, with some homes having roofs of plaster, cast on frames of bamboo bark. The geometry of the techniques was adapted according to the preferences of local builders.

The project consciously set out to make maximum use of materials that could be found locally or developed on site. This led to the use of:

- cement for concrete foundations and floor finishes;
- locally-fired or stabilised bricks for walls and domes/vaults;
- lime for internal and external finishes;
- gypsum plaster on bamboo frames for some roofs;
- timber windows and doors.

The construction technology developed under the projects was largely the result of the process of research and development conducted on site by the ADAUA team. This process aimed to develop and demonstrate a range of affordable alternative techniques for self-built housing.

With the exception of the 12 model homes in Rosso, few of the homes built under the projects enjoyed any on-site services. Three standpipes provided potable water for the population of the Rosso site,

but even at the time of their installation this was inadequate. The camels of the nomads have given way to donkeys drawing water-carts, which are the source of much of the water used in homes. There were plans to develop composting latrines (with support from UNICEF) as part of the Rosso project, but it is not known if these were ever built. Most homes have rudimentary external dry latrines, with separate facilities for ablutions. Drainage from the sites is provided by means of open channels, some of which were upgraded as part of the projects. The principal drain that was built through the Rosso project is now filled with waste and stagnant water.

Origins of:

Technology

The technology used for both projects derived partly from research undertaken on the site (in Rosso) and partly from external sources. While there is no tradition of dome-building in this part of Mauritania, a combination of models was chosen, on the understanding that these would best suit the local conditions. The sources

for the technology included the Nubian vault and dome (which was receiving widespread publicity at the time, due to the work of Hassan Fathy) and Iranian examples (which were also published at the same time). The synthesis of these techniques with methods that would use locally-available gypsum was the basis for the construction of the model houses and other structures to serve as demonstrations of the "improved" technology.

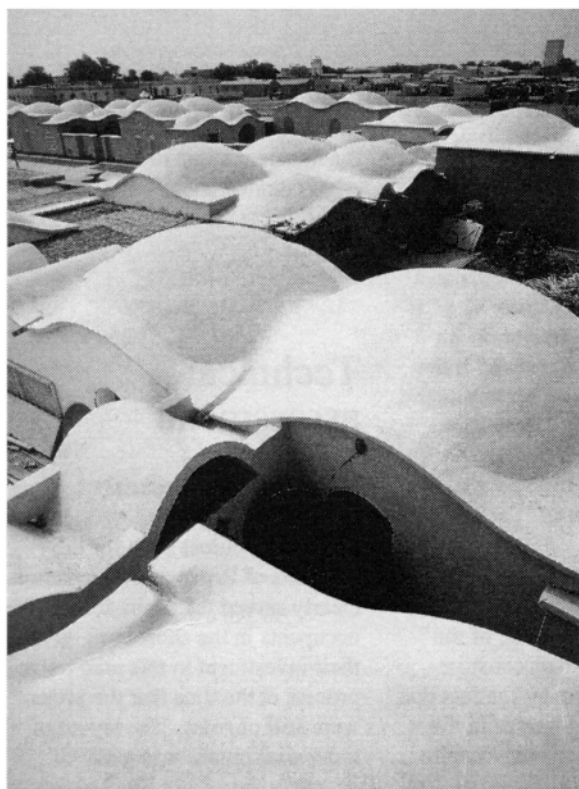
Materials

An important objective of the projects was the use of materials that were found or developed locally, in order to reduce the dependence on imports. To this end, sun-dried and stabilised bricks, made from earth extracted on site, were used for the structure. In addition, gypsum from a source close to Nouakchott was used for the structure, on bamboo frames, for some homes. In addition, lime fired from locally-collected seashells was used for wall finishes. Cement used for foundations and floor finishes was imported.

Labour force

The labour force for the construction of homes was entirely local, with some 35% having specialist skills. A community workshop was established in Rosso to train 30 masons in the techniques of the prototype dome and vault houses. A total of 80 masons were trained during both projects.

In addition, up to 500 residents were employed for labour-intensive upgrading works on the sites at different times. The development of



Variations of vaults and domes were developed to demonstrate construction techniques for the original pilot project

community groups to undertake upgrading work was an important part of both projects. In the case of Rosso, the organisation of self-help building "brigades" for men and "community services organisations" (for women) helped to act as a focus for community participation at the early stages of the project.

Professionals

The team of professionals working on the projects comprised nationals of Mauritania, Senegal, Switzerland, Spain and France.

Construction schedule and costs

History of project

The Rosso project served as a pilot to explore the potential of innovative building techniques and materials in the urban context. Based on experiences with this first initiative, it was

decided to extend the activities to work in a similar context in Nouakchott.

The Rosso project began with field work between 1975 and 1977, during which an ADAUA team comprising architects, engineers, a sociologist and a social welfare officer were able to make a detailed assessment of the physical and social context of the settlement. This was followed by the construction of a "pilot" home to serve as a demonstration of the outcome of the research. The building of an additional 12 model homes followed, during which masons, brick makers and plasterers were trained.

This process of building model homes continued until 1978, when the site was evacuated as a result of flooding caused by heavy rains. When families returned to their flood-damaged homes after the rains, project activities turned to the construction of protective structures and drains to reduce the risk of further damage from flooding on the site. Partly in response to these events, a collective housing pro-

gramme was begun in 1981, which involved the production and use of fired bricks, together with a kiln to produce lime from locally-available shells. In addition, a workshop for carpenters and metal-workers was established, and 80 craftsmen were trained in a variety of techniques related to the housing project.

By the time of completion of the drainage works in late 1983, the final allocation of land for housing on the site in Rosso had been made. At this time, the carpentry and metal workshops were reported to have closed, and the kilns ceased production. By this time, 260 homes (out of a planned total of 1,400) were reportedly built using techniques derived directly from the ADAUA model.

Costs and financing

It has been impossible to determine the overall costs of both projects from available records. It has been recorded that a sum of US\$ 131,000 was paid for the purchase of the Satara site in Rosso from the local authorities. External support was also provided for the infrastructure improvements on the site from UNICEF and the World Food Programme. The total cost of the Satara integrated development project (sponsored by UNICEF and the Mauritanian government) was estimated at US\$ 3,274,400, but it is not clear to what extent this affected the ADAUA-implemented programme.

While significant subsidies were offered for house-owners to make use of approved techniques, the principal resources for improved homes came from the families themselves in both projects. In Rosso, local residents were charged the equivalent of \$0.41 per square metre, or \$1.40 per square metre for non-residents. The disparity was presumably to avoid speculation on the actual value of the land. In addition, a deposit either of the

equivalent of \$56 or ten days of community labour was required for communal infrastructure by applicants. Attempts were made to set up a community savings scheme to enable families to borrow this amount and repay over two to five years. It is reported that fewer than a third of borrowers have repaid their dues to the local administration.

Comparative costs

Based upon estimated costs gathered in 1983, the cost of a typical ADAUA model home was between \$75 and \$94 per square metre. By comparison, the cost of a typical informal brick house (with a pitched corrugated iron roof) was put at between \$66 and \$75, while that of a "superior" concrete frame house was put at between \$140 and \$150. It is instructive to note that the estimated construction time for the ADAUA home is put at twice that of a conventional home, thereby adding considerably to the actual costs.

The experimental nature of "improved" construction or materials manufacture in both Rosso and Nouakchott doubtless increased prices beyond those of materials more commonly used in squatter housing, but provided local builders, albeit briefly, with a cheaper alternative to conventional modern materials.

Any direct comparison between the costs of the few "model" homes built and the actual costs of rudimentary shelters that characterise the

settlements is, however, of limited use. The residents of informal settlements throughout the world make optimum use of available resources to create basic shelter in a manner that they can afford. The opportunity cost of innovation (in terms of potentially improved living conditions) needs to be set beside the increased capital cost in any such appraisal.

Maintenance costs

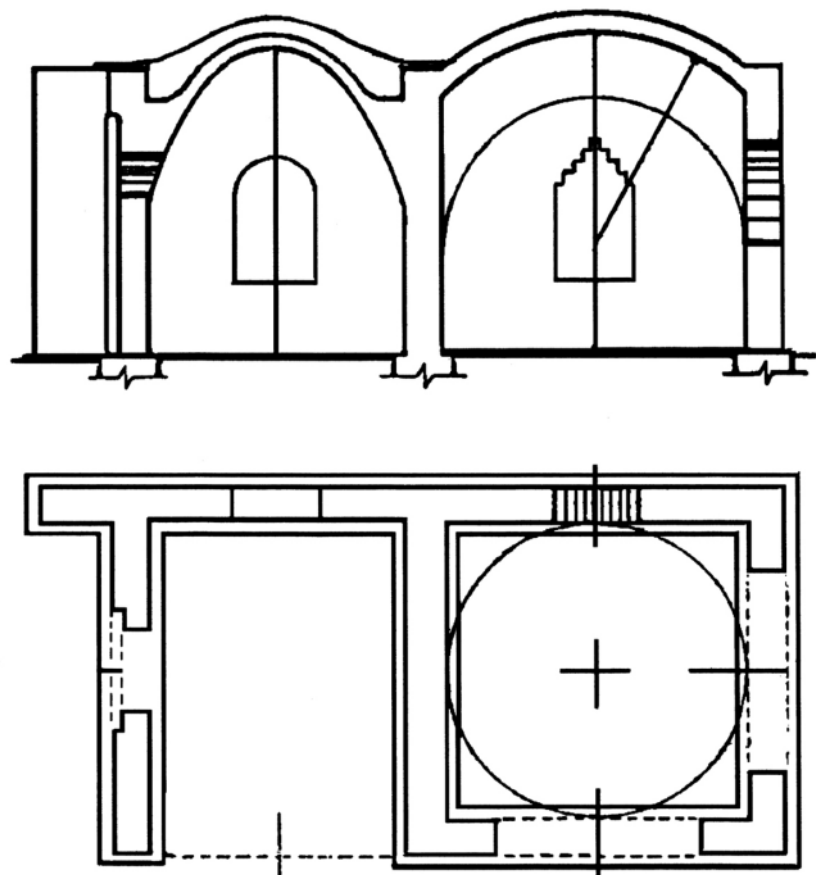
The cost of maintenance is likely to have been one of the reasons behind the radical changes to some of the model homes since their construction. This is borne out by the fact that few of the remaining homes in the projects are in good repair. Despite

the apparent value of the land upon which domed house were built, in several cases these were seen to stand in ruins.

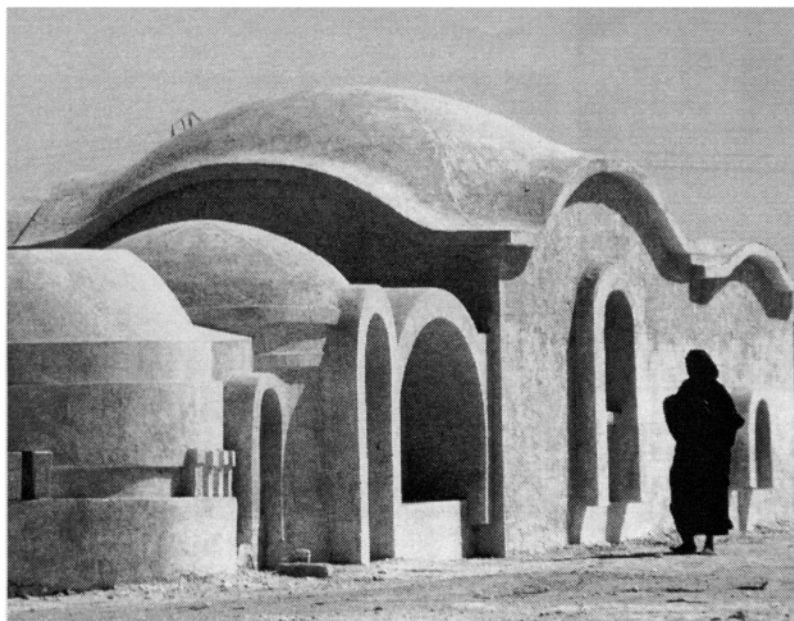
Technical assessment

Functional assessment

The model homes built for the residents of Rosso and Nouakchott clearly served the aspirations of the occupants in the short-term, given their investment in this innovative process at the time that the projects were still ongoing. The layout of individual homes was well



Section of the first prototype, consisting of two rooms covered by a vault and dome



*Original prototype
of Nouakchott
housing proposal,
using local building
materials*

thought-out, and met the functional requirements of the families inhabiting them. In the longer term, however, the occupants clearly turned to more conventional models in their attempts to secure shelter. Whether this was partly the result of the closure of the enterprises (brick and lime kilns, workshops, etc.) that were intended to support the construction process is difficult to determine so long after the project implementation. The fact remains that the innovative technical ideas of the projects had very little real impact on the living conditions of more than a handful of the inhabitants. It is evident that conventional building forms, even where these may be more costly than innovative ones, continue to serve the needs of the bulk of the population.

Climatic performance

The climatic performance of buildings with a high thermal mass in this context is mixed. Most of the “traditional” homes in the settlements make use of lightweight materials, which allow the occupants to take

advantage of diurnal temperature fluctuations, and cater to the need for mobility. The brick-built homes of the project were reported to be “airless”. And yet the openings for cross-ventilation inside pilot houses were reportedly blocked by the occupants within a year or less of their construction, given that they allowed dust to be blown into the rooms. By contrast, many of the homes built from “found” materials in the settlements enjoy floor-level openings that permit good cross ventilation, while enabling the occupants of the room at the back to enjoy some privacy. The issue is less one of technical performance than of acceptability.

Choice of materials and level of technology

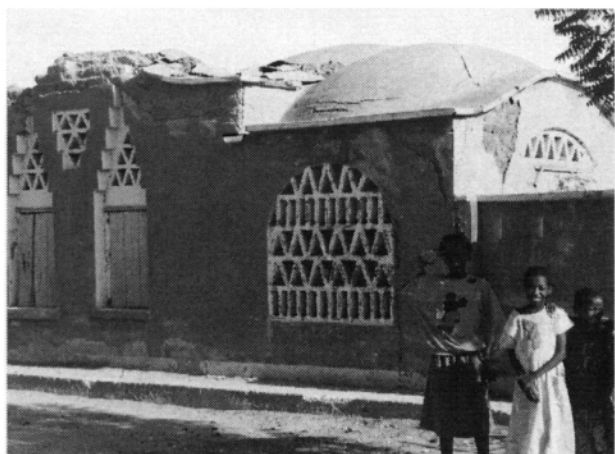
In the context of an (allegedly) thorough analysis of the technical and social context by ADAUA, the choice of materials seems to demonstrate a limited understanding of local conditions. Not only did the original brick homes suffer from major damage (along with other

forms of construction) during flooding, but even the “improved” materials have not withstood the test of time and climate. Only one house visited in Rosso appeared to be in a good state of repair. Several homes stood in ruins, and most had serious cracks.

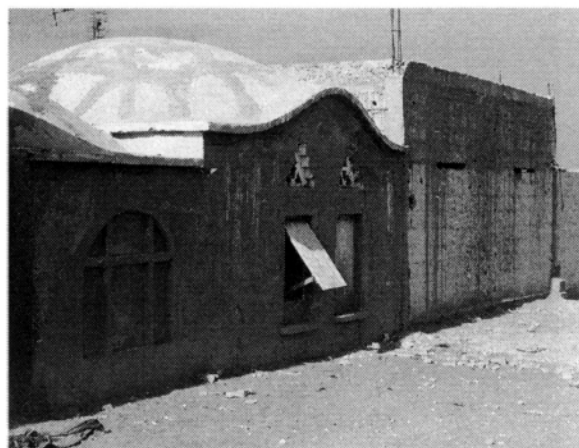
Whether the evident “failure” of the technology in the projects was as a result of the poor maintenance or poor choice of materials seems of little importance. In a programme that set out to demonstrate new techniques, and therefore seek acceptance for innovation, users are likely to be unforgiving towards ideas that do not suit their immediate needs. It can only be concluded in these cases that the introduction of innovative technologies seems, to some extent, to have been adopted as an end in itself, without heed being paid to the context in which they were supposed to function.

Users

Those who benefited from the projects were communities forced to the outskirts of the towns of Rosso and Nouakchott by a combination of environmental and social forces. These people are primarily of Toucouleur, Soninke and Haratine extraction. Based on surveys conducted among residents, six out of ten people in Rosso were involved in commercial or agricultural activities.



*The Satara zone
housing units
pictured here in
1994*



Two out of ten were unskilled, depending on casual labour for their livelihood.

User response

The initial response to the allocation of land under the projects was said to have been mixed. Resident families were reluctant to pay officially-sanctioned fees for land, calculated on a square metre basis, which was intended to meet some of the development costs. In addition, a flat fee was levied for each potential house-owner, in order to meet the costs of drainage of the site. The limits of possible development for sites in Rosso were seen to be too restrictive for many potential applicants. In order to widen interest, families from outside the Satara area were invited to participate, building

restrictions were loosened and subsidies offered by ADAUA management for those using approved techniques. This saw a significant growth in interest, with the result that the plot sizes were halved to meet the demand. This, however, resulted in complications with the local authorities, who refused to provide titles for homes built "without approval", allegedly because of the occupation of a strip of land not originally allocated to the project. In addition, the local authorities refused to take responsibility for the site from ADAUA before drainage works were complete. ADAUA did not have the resources either to complete the drainage, or to reimburse deposits for those families not relocated under the project. Finally, the government refused to release land for the second phase of

the scheme until these disputes were resolved. In the face of this adversity, the Dutch, Canadian and Swiss donors of the project withdrew their support, arguing that only a fraction of the planned numbers of homes had been built.

Project personnel

Professional staff from the Collectif d'Ateliers ADAUA were involved in the development and implementation of the approach. These included the architects Josep Esteve, Jak Vauthrin, Serge Theunynck, Birahim Niang and engineers Saikou Thiam, Ladj Camara and Lamine Ben Barka.

The client was the Ministry of Housing of the Islamic Republic of Mauritania, through the local Société de Construction et de Gestion Immobilière en Mauritanie (SOCOGIM).

***Jolyon Leslie
April 1995***



*The Satara housing
units in Rosso, after
more than 10 years
of habitation*