HOUSING MARKET DEMAND, HOUSING FINANCE, AND HOUSING PREFERENCES FOR THE CITY OF KIGALI

EuropeAid/127054/C/SER/multi

CHAPTER 3

HOUSING TYPOLOGY STUDY

CONTENT

EXHIBITS

ACRONYMS

DU	Dwelling Unit
FAR	Floor to Area Ratio
KCMP	Kigali Conceptual Master Plan
KIST	Kigali Institute of Science and Technology
Ha	Hectare
MININFRA	Ministry of Infrastructure
RC	Reinforced Concrete

1. EXISTING HOUSING TYPOLOGY IN KIGALI

1.1 Introduction

Typology is the classification of characteristics normally found in urban places and in buildings. Accordingly, it can be studied at a) urban and b) architectural scale.

a) Where *urban typology* in new environment is concerned, it is convenient to observe the variation of typology as function of two crucial parameters: a) <u>density</u> and b) <u>height</u> of the buildings. When one is kept constant, the variation of the other can be observed, within a given extent. The lower and upper limits of these parameters deemed as applicable to the concrete Rwandan reality will be discussed. Visual tests will be performed on discrete values o the parameters, in order to give a physical feeling of the resulting urban landscape. Various other density/height combinations can be deducted by interpolation.

b) *Architectural typology,* as definition of plans of dwellings, their aggregation in buildings and the layout of the buildings in spatial relationship to one another is better left for subsequent study and design. At this stage, it will be sufficient to adopt dimensional standards imposing the minimum constraint to the future work of the architects. Small scale physical characteristics of the housing, and the final aspect of the buildings will be the result of the responses to the requirements by the plural agents of the urban scene: administrators, architects and developers. However, to spell out the principles that the actors of the urban scene will be requested to comply with, the following exercises are to be carried out:

- The Planning parameters defined in the Kigali Conceptual Master Plan, the Sub Area Plans and the Detailed Plans adopted so far will be reviewed;
- The housing conditions in Kigali and existing typology will be reviewed.

The subject of housing typology in general will be dealt with in accord with the logical path of exhibit 1.

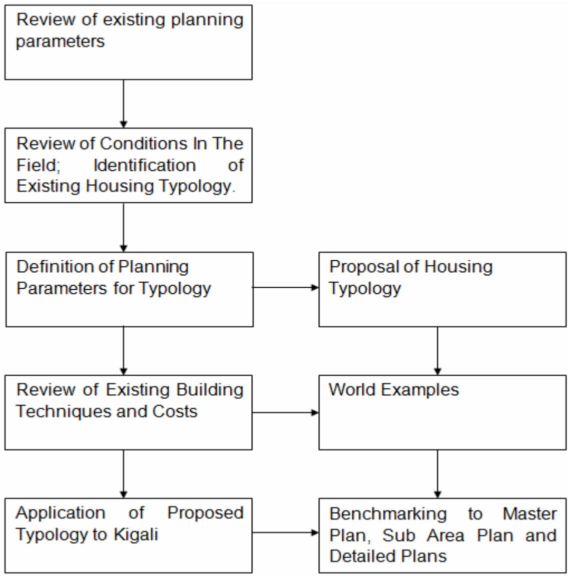


Exhibit 1 Plan

1.2 Housing Typology and Planning

The Kigali conceptual Master Plan (KCMP) has been launched in 2007, presented and adopted by Parliament in 2008. Soon after the detailed district Plans of Rebero, Kininya, Kimihurura, Masaka, followed, and the remaining will be presented shortly. The Kigali City One Stop Center and the Rwanda Housing Authority (MININFRA) were created to implement the Government policy and have already promoted several initiatives in planning, administration and research. Our study of the housing market is one of them.

The views of the Master Plan, the Sub Area Plans on housing typology are summarized below.

1.2.1 Kigali Conceptual Master Plan Typology Requirements

On the typology issue, the thrust of the Master plan is qualitative. The main guiding principle of spatial organization is the Transect concept, which is synthetically defined thus:

A transect is a cross-section of a defined geographical area, used to reveal a simplified sequence of diverse zones of a complex environment. Originally, the transect was used to show varying characteristics of different ecologies in a natural environment … For human environments, such a cross-section can be used to identify a set of habitats and land uses by their level of density and intensity of urban character, a continuum that ranges from rural to urban … Generally, the urban centers should be located on tops of hills with less density on steeper slopes. Neighborhood community centers should be centered around primary schools. Neighborhood community centers should be located within convenient walking distances, which would accomplish several goals[1].

[1]KCPM p.76

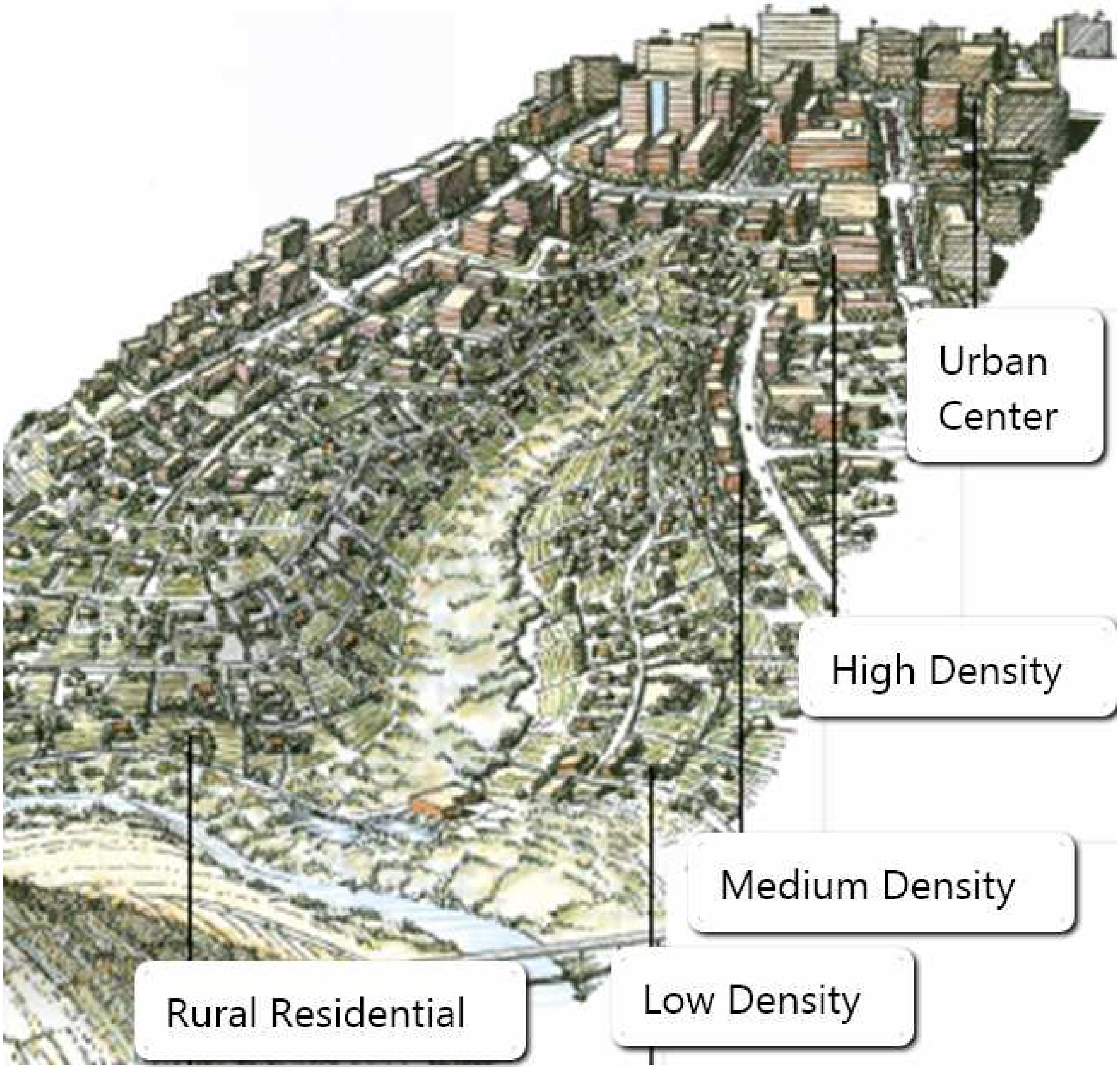


Exhibit 2. The Transect Concept

Concerning specifically the housing patterns: *they should express the needs and desires of the community for a range of households, (including nuclear families, extended families, women-headed and orphan-headed households, and collective households) with appropriate identity, privacy and security. This housing model could include an individual home of perhaps three rooms*[2] *(sitting room and two bedrooms) with a toilet, kitchen and outdoor space for play and garden will meet the essential needs of a four-person household. Roof rainwater harvesting, proper control of drainage and septic waste handling are important components to insure well being*[3]*.*

[2] *This is an example: there are different configurations for different sized families and situations.*

[3] KCPM p. 67

As shown in the Land Use Map in Exhibit 3, these principles are applied in the land allocation of the Master Plan: high density habitat (*tan*) toward the top of the hills, medium (*orange*) and low (*yellow*) density on the steeper slopes.

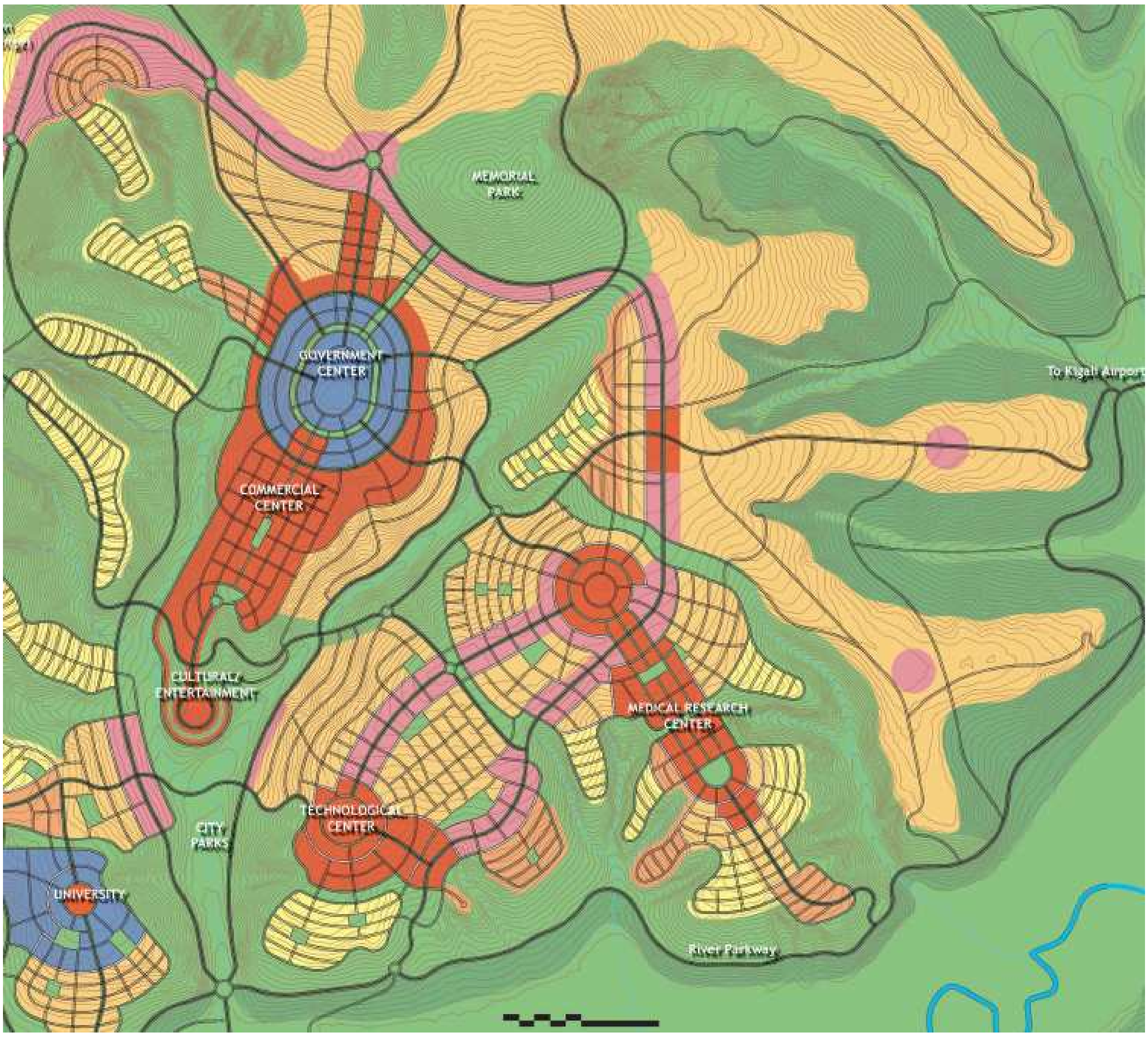


Exhibit 3 KCPM Land Use Map

1.2.2 Sub Area Plans Typology Requirements.

These Plans present various images of how parts of Kigali would look in future, if the transect model was applied. The curve disposition of the buildings naturally follows the contour lines of the hills. Potential images of peripheral communities are presented, such as this view of Kinyinya's Community Center. The Land Use and density requirements for housing are as shown in Exhibit 4:

DENSITY	**DU/ Ha**
Med.-Low Density	~70
Med.-High Density	~140
High Density	~200

Exhibit 4 Sub Area Plans Density Standards

Exhibit 5 View of Kinyinya neighbourhood

Exhibit 6. Schematic Residential Layout

1.2.3 The Detailed Master Plans for Nyarugenge and Kinyinya District

All information in Exhibit 7 and 8 are extracted from the detailed zoning plans for the two Districts, of Nyarugenge and Kinyinya that are currently applied by the City of Kigali.

TYPOLOGY	FAR[4]:	HEIGHT
Single Family Residential (R1)	0.8 max	G+1max
Mixed Single Family Residential(R1A)	1.0 max	G+1max
Low Rise Residential (R2)	1.4 max	G+4 max
Medium Rise Residential (R3)	1.6 max	G+7 max
High Rise Residential (R4)	2.4 max	G+15 max

Exhibit 7 - Density/Height Standards

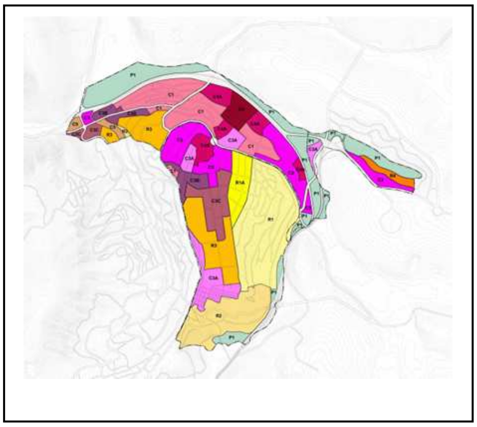


Exhibit 8 - Zoning Map of Nyarugenge

The unit used by KPCM and Sub Area Plans to measure urban density (Dwelling Units per Hectare) are not the same as those in the Detailed District Plans (Floor to Area Ratio). To compare the parameters of this study with them, both DU/Ha and FAR are indicated in the section 2 about parameters below[5].

1.2.4 On Building Codes and Regulations

[4] Means the gross floor area of the building or buildings on any plot divided by the plot area.

[5] To calculate the floor area, a more operative tool than the DU/ha would be the FAR (Floor to Area Ratio). In the conceptual Master Plan and schematic Sub Area Plans the FAR is not indicated; The FAR could be deducted from the DU/Ha data only if the average gross size of dwelling was known (by multiplying the number of dwellings by the average size and dividing by 10,000m^2-one hectare). However, the average size of the apartment is a difficult guess. The Master Plan mentions a two-bedroom apartment but warns that this is only given as an example, so three or four bedrooms are also possible; moreover, a variable number of people per dwelling is given (3 to 5 in the Master Plan, only 3 to 4 in the Sub-area plans).

A great attention has been given by the Government, in particular by the Ministry of Infrastructure, to ensure that new buildings, especially those to be used by the public, are designed following established architectural standards and calculated and executed in accord with sound engineering practices.

—In 2006, the Norms of construction and urbanism in Rwanda, prepared in collaboration with UN Habitat, were published by MININFRA.

—The 2009, the Law governing construction and urban development has been passed by Parliament and is expected to be gazetted soon.

—In 2010, the MININFRA published the Rwanda Building Control Regulations *"to promote an adequate, safe and well maintained building and transport infrastructure"*

—MININFRA has published, also in 2010, the setting conditions for the delivery of Building Permits. The control on the respect of these conditions is entrusted to a Committee, not yet established, but expected to take the form of Councils, at central and local level[6]

—Waiting for the Law governing architecture and engineering services in Rwanda to be approved by Parliament, MININFRA has issued provisional instructions on the matter, fixing the rules of provision of those services by Rwandans and expatriate, and giving the two Associations –of Architects and Engineers– authorization to register certified professionals in the respective fields.

—Standards are being examined and adapted to the Rwandan conditions by the Rwanda Bureau of Standards.

The latter is a huge task and it will presumably take years. Meanwhile, following the Rwanda Building Control Regulations quoted above, architectural design and engineering calculations *"shall conform to the "approved standard specification, design guidelines, or the British Standards".* In other words, any serious construction code (including obviously the Eurocode) approved and applied in other countries is also applicable in Rwanda for the matters not yet covered by the Rwanda Bureau of Standards.

The question necessarily arises of whether there are enough qualified professionals in the country to properly design and control all construction activity, both at present and in the "booming" future. This question is being attended by the University of Butare, KIST and other higher education institutes. However, interpreting, using, applying and controlling quality and safety standards as Eurocode or British Standards is a tall order, and nobody can

[6] Personal communications of Eudes Kayumba, former President of the Architect Association.

affirm to be really competent in more than one specialized field. It happens that developers and contractors are left to their own devices, and sometimes they are not up to the challenge. Two examples of disregard of the basic norms of safe construction are given below.

Exhibit 9 Example: This building had been initially constructed with the ground floor in recess from the upper floors, without the columns at the two front corners. The columns have been added after cracks appeared which are still visible.

Exhibit 10 Example: The columns of this church are non-existing; they are just an effect of the plastering.

1.3 Kigali Today

Projections indicate that the Kigali's population will double in ten years. Kigali, as most cities in the modern world, is attracting ever more people in search of job opportunities, self improvement and a better future. Like all major cities in a rapidly urbanising world, it will have a major role as the **engine of the transformation of the Rwandan economy**. As stated in the Vision 2020 document[7] :

A conducive environment will be built to enable Rwanda's economy to diversify into the secondary and tertiary sectors, whilst in the long run an entrepreneurial middle class will take over the main thrust of Rwanda's development effort from the State and foreign donors.

The *conducive environment* can only be urban. Indeed, despite the huge challenges that life in the City presents, and the amount of suffering that difficult living conditions produce, the human potential is amplified by education opportunities, gender equality, and direct exchange of ideas among people. Intense social exchange stimulates all minds.

[7] *RWANDA VISION 2020*-MINISTRY OF FINANCE AND ECONOMIC PLANNING, Kigali July 2000.

The *entrepreneurial middle class* can find only in the City the competence necessary to nurture the knowledge-based economy that the Vision 2020 has conceived of, and that Government has steadily pursued since, promoting science, education and technology.

Kigali is becoming the incubator of innovation, and this in turn helps designing a more sustainable city: saving natural resources, implementing new energy-producing techniques and reducing the impact on the environment.

Indeed, in 2008, Kigali was inscribed in the United Nations Habitat Scroll of Honor with the following motivation:

Kigali shines as an example of a harmonious city

The actions that had been taken by the City in the previous years to obtain this excellence price are:

- Garbage collection
- Ban of plastics
- Beautification of streets and pavements
- Public Transport
- Sewage system
- Slum improvement
- Ban of smoking in public spaces
- Ban of fuel guzzlers on Government officials

In addition to the above, it is worth mentioning the 2005 Rwandan Government ban of the use of burned bricks in construction, and of the charcoal as a cooking fuel. These measures were needed –and it was high time to enforce them, in order to check rapid deforestation throughout the country. However, the switch to other construction materials has been slow, because of the high cost of the industrial bricks (using gasoil), and the resistance of the contractors to the use of the concrete blocks (cement is rare and therefore expensive, while good clay for bricks is plentiful in many places, like in Musanze for example, and a brick construction, even modest, looks better than a block construction.) As for other sources of energy for cooking, the same resistance is to be noted against electricity and gas, because of the high costs and the fear that gas might cause explosion if used by minors, servants, etc. More efficient stoves using timber fuel are available, though not widespread. Solar energy is still used at a minimal extent.

These issues are most relevant to housing, raising the ante of affordability, and putting constraints on typologies requiring “modern” cooking habits. Authorities have tried to reduce the impact of the bans by issuing waivers of the rules on a case by case basis, and giving limited authorizations to local association producing charcoal and burned bricks, provided that they would use fuel timber grown for that specific use, agricultural waste, spent lubricant, sawdust, etc.

Since the UN award, the pace of improvement on all matters has sped up. Elegant buildings dedicated to administration, convention centres, etc. have risen in the central and environing districts, giving new strong character to the city’s skyline. New road and streets pavement, drainage, sidewalks, traffic lights, are to be seen everywhere. When this action is extended to all neighbourhoods, pedestrians will finally walk safely separated from motor circulation.

Exhibit 11 View of the Central Business District.

Exhibit 12 Views of the Gikondo crossroad.

Electricity and water supply are significantly better, though the costs are considered as too high by the poorer families[8].

[8] The cost of the electricity is 140 RWF/KWH at peak hours, from 5 to 11 p.m. People in the income ranges from 0 to 400,000 FRW/month are generally renters; most have electrical connection, but no water in the house —or room. They don’t have refrigerators or electric stoves, just a few light bulbs and sockets. They might use about 40 KWH/month, for a bill of 4000 to 6000 RWF. Beyond this income range (400,000 and above), if a households owns a refrigerator and a stove, even carefully managed, they might have to pay around 30,000 RWF/month.

These high profile accomplishments have not diverted the Authorities from special concerns such as, for example, people with disabilities, asbestos eradication, etc.

Moreover, the spreading of slum areas has so far been contained, despite the increasing pressure of the demographic growth. This has been obtained by strict surveillance by local Authorities, monitoring the sale of land parcels and curbing illegal construction. From time to time, demolition sessions are organized, such as for example, the one carried out in Gisozi at the end of 2011. This is extremely important because it shows that the future developments can be efficiently managed and monitored by the local authorities with the participation of the inhabitants.

1.4 On Existing Housing Typology

If a family looks for a house, the choice it is given is rather restricted. The broad categories of available housing have been characterized as follows in the World Bank Housing Sector Assessment of March 2012.

FORMAL

The buildings classified in this typology are considered formal because a) they are recognized by the City of Kigali as compliant with the Planning Standards set by the Detailed Master Plans and are built in durable construction materials, or b) are located outside the zoning of the Plans where the standards are less strict. It is made up by these types:

Single-family houses, urban: they occupy large parcels of prime land and are often surrounded by beautiful gardens in existing or newly built housing developments in Kiyovu, Kimihurura, etc. They generally have 3 to 6 bedrooms, and they own or rented only by the richest part of the population.

Apartments in multi-storey buildings, urban: they are not a frequent sight, but they are present in all part of the city. They have generally 1 to 4 bedrooms and are built in reinforced concrete framework construction. They are mostly rented at high rent rates (USD 2,500/month) and therefore they are accessible only to rich Rwandans (most of whom already own a house) or, more frequently, to foreigners.

Exhibit 13 New family houses in Gikondo

Exhibit 14 Apartments in multi-storey in Kacyru

Single-family houses, sub-urban: built on large parcels with temporary materials, often in several stages, inhabited by low to medium income owners or renters.

According to the World Bank report quoted above, they become more and more frequently a solution for people who cannot comply with the building codes of the city, but can afford to buy relatively cheap land outside the city limits and build their house of 3-4 bedrooms with temporary materials, mainly mud bricks.

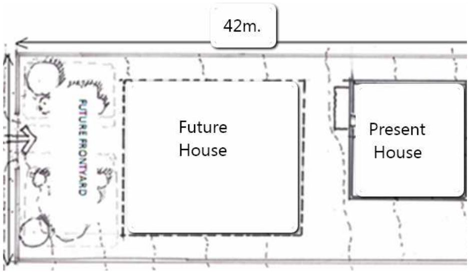


Exhibit 15 Sub-urban House in Gatare

Other types, urban: different types of housing are rare, and they are also inhabited mostly by foreigners. One example of five mono-family houses in a row is shown below.

Exhibit 16 Five Houses in a Row in Kiyovu

Some interesting pilot projects have been realized, such as the Batsinda neighbourhood of decent mud houses, which have basic features appealing to the low-income people.

Unfortunately this god example cannot be reproduced as it is, because houses are still scattered in a large area. Also, it seems difficult for the inhabitants to walk to town, if they want to spare the money of the ride.

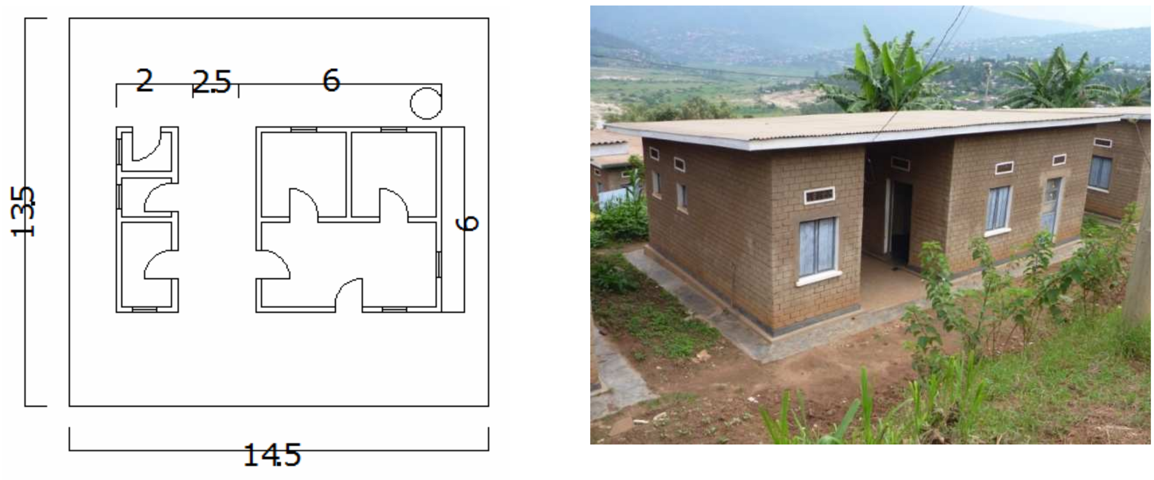


Exhibit 17. Auto-construction in Batsinda

INFORMAL

This typology is considered as informal –despite the fact that a large part of the owners have land titles– because they are not compliant with the Planning Standard applied by the City of Kigali, or are built in what are considered as temporary materials. It comprises of the vast majority, almost totality, of houses available to the low-income sectors. It can be divided in the following types.

Single-family house, urban: they occupy medium-size parcels (100 to 600 m2) built with traditional mud brick technique: two or three bedrooms and a small living room. They are at times decent, at times dilapidated, but they are not allowed to be improved by the rigidity of the building code. They are owned or rented by medium income families.

Exhibit 18. Family House, Nyakabanda

Rent houses, urban: owned by “poor landlords”, occupied by many households or singles (2-4 m2/person), often including the landlord. They are most often located in the interstices of the official city and are in poor conditions, especially sanitary.

Exhibit 19. Rent Houses, Kimisagara

“Slum”, urban: sometimes in the fringes of the previous type. Small temporary shelters made of makeshift materials by the poorest section of the population. Often connected, legally or not, to the electrical grid, but very seldom to the water main. Unsanitary (sometimes human waste is disposed of in nearby marshes at night.)

Exhibit 20. “Slum”, Kacyiru, Gasabo

From the above summary review of the existing typology it appears that one-family isolated houses, whether as villas in wealthy neighbourhood or as single-room hut in a dense suburb, are the large majority of the existing stock, and they are sought by all as the ideal homes. New developments being built in all areas of the city and around follow the same pattern. However, this pattern cannot be extended indefinitely to cover the future expansion of the city, since the low density of inhabitants that it yields is insufficient. This is evident from the density indications of the City's planning documents reported above, which clearly prescribe higher numbers of dwelling units per hectare than in the existing urban fabric. The subject of the next section: Parameters will be the identification of the *minimum* densities allowing controlled growth of the City without entailing excessive promiscuity to its inhabitants.

1.5 Clues for a New Housing Typology

The gap between actual Kigali and the housing needs of its citizens is great. This is where the Master Plan and the area plans become essential. However, while the long term vision is a necessary guide, it can only be implemented by incremental steps, each phase learning from the prior how to adjust the policy to reality[9].

The houses that people build and occupy can inform the planner about their priorities and preferences. What can be observed in the informal housing of Kigali, where most of the present population lives, is that dense settlements are already a significant part of the existing typology, closely knitted with the official City, and this despite often uncomfortable living conditions.

The general conclusions that can be inferred from these observations are:

1. The urban density requirements of the planners are already implicitly implemented in the housing conditions of most Kigali inhabitants. Given the choice between "formal" large sub-urban houses and "informal" huts in urban Kigali, they choose the second alternative. Hence, they are prepared to accept to live in close proximity with their neighbours, provided that they have a roof above their head, and that it is located as close as possible to where the City's bustle takes place, as potential workplace. The most important feature of housing appears to be the same for the broke journal worker and the millionaire developer: *location*. Infrastructure and amenities: roads, water, electricity, neighbourhood services: schools, health centres, leisure areas, come second in the hierarchy of most urgent needs, which is shown by the fact that their present absence is not a prohibiting factor.

[9] For monitoring eventual progress, abuses, etc., it might —or might not— be possible to apply a new technique: drones equipped with cameras and adequate software. The advantages and risks of their use for these purposes should be evaluated.

2. The stress of uncomfortable living conditions is not expected to last forever. It is tolerable only in the perspective of a better future which is hoped as the result of the social improvement that only the City can provide. The present hut is only the seed of a gradual *evolution* toward the house that is the vision and the hope of all families. The starting point must allow potential room for this evolution. Indeed, a sentence that is repeatedly quoted as an unachievable delusion: "Rwandan like space" should perhaps be interpreted as: "Rwandan like to have at least enough space to allow future improvements of their dwelling", and this seems to be a reasonable demand.

   The above findings lead to conceive of a habitat of sufficient density in which all income strata can benefit from the opportunities offered by the proximity of the City centre. Whenever possible, informal settlements should be upgraded[10]. When the ground they occupy presents hazards, creative solutions can still be considered to make it safe and architecturally attractive[11], before the last resort relocation option is chosen. Where this transfer is, after all, inevitable, it should be made to new socially balanced redevelopment areas where the adequate housing for ex-informal dwellers is part of a combined typology. This should avoid the formation of ghettos and slums.

   Many other capitals around the world have tried to apply the relocation policy, only to see the houses in the new site occupied by others, while the inhabitants of the demolished settlement either found a new similarly inappropriate location, or went to increase the number of destitute slums. Informed and creative use of the Master Plan and the input of architectural experiences and ideas from other parts of the world could prevent this from happening to Kigali.

   The main conclusion of this section is therefore that a successful strategy should aim at reproducing at urban scale the spontaneous typology, although in an orderly and hygienic way. In other words, the policy should organize and encourage the gradual evolution from "informal" to "formal" housing.

[10] Rehabilitation requires at times extensive action, but in some cases even small actions may have great impact in people's daily life. Example: generous diffusion of public taps, carefully designed to avoid water wastage.

[11] See the "Algerian" and "Japanese" solutions in the World Examples

2. PARAMETERS

2.1 Objectives and Relation to Existing Conditions

The aim of this section is to provide the City planners in charge of housing with tools apt at evaluating the results of the application of the main parameters which define typology. Two of these parameters are spatial: *density* of the urban fabric and *height* of the buildings. The third main parameter is economic: construction *cost*. This analysis will be carried out bearing in mind the conclusion of the previous section, which allowed some preliminary assessment of the specific features of the Kigali urban environment and of the basic needs and aspirations of its inhabitants.

Planning of housing is a balancing act. A modern city of multi-million inhabitants requires sufficiently dense urban fabric to allow rich human interactions, and access to work and services in reasonable time; also, in a compact City the length of infrastructure is reduced.

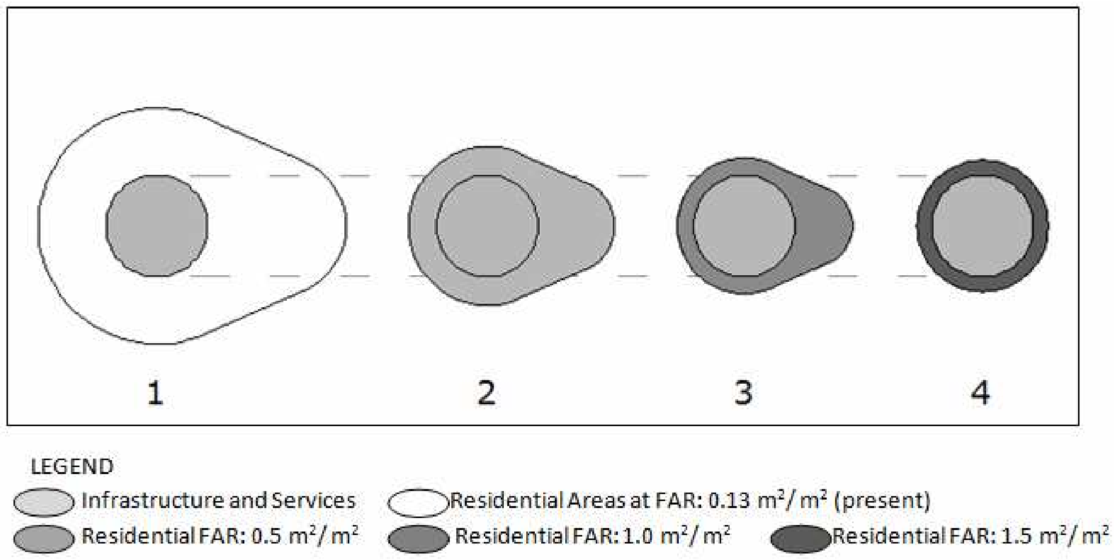


Exhibit 21.Simulation of Kigali's residential areas at different densities: 1-present; 2-low 3-medium; 4-high.

On the other hand, entrenched frames of mind, cultural attitudes and cherished living habits make people look for a house to build "from the ground up" and this require precious space. This is the challenge to be addressed: to find the overlapping, if it exists, of these divergent requirements, in order to design sensible living space that would be attractive, if not to the mature, at least to the young future inhabitants of the city, with practical solutions for a smoother transition. An appropriate typology must comply with these requirements: it must allow acceptable densities, as defined by the planning documents (analyzed at numeral 1.2 of the previous section) and afford minimal living conditions and improvement opportunities to the people.

2.2 Methodology

In accord with these principles, the typologies will be evaluated by keeping unchanged one of the two spatial parameters, and observing the possible range of variation of the other. The results will show what kinds of types are allowed by the application of a given density, and conversely what densities can be reached by developing housing of selected heights.

On the basis of these results, a few theoretical simulations can be carried out, which will give a direct visual feeling of the spatial results of the application of different parameters. This is a theoretical exercise: the actual aspect of the architectural result is not yet defined. This study will not pre-empt architectural creativity by proposing specific designs of selected types. However, the important issue of the quality of Kigali's architecture will be dealt with in two ways:

- Design philosophies and styles are going to be presented for discussion (World Examples) to accommodate different approaches and sensibilities.
- Mechanisms will be proposed to enlist spirited international competence for the design of the future Kigali.

2.2.1 Units of Calculation

To build concrete spatial patterns it is necessary to first adopt a few appropriate dimensional units which will remain constant throughout the simulation. They have been chosen as an average of most applied standards and general consensus among professionals in the field (*good practice*). They can be tweaked though, within a reasonable range, without undermining the concept.

<u>Unit of Land</u> (same size as Unit of Construction) = <u>90m^2</u>

This is the minimum size of a parcel that could be assigned to a family, allowing an initial temporary dwelling which can be enlarged and improved by further additions, hence the coincidence of unit of land and unit of dwelling (analysed below). It represents about half the Batsinda parcel described before.

<u>Base Plot</u> = 32 Units of 90 m^2= <u>2880m^2</u> (60m x 48m) surrounded by 12m-wide circulation/buffer space.

It has been calculated to support a number of dwellings from <u>16 to 48</u>, which is considered as an appropriate size of urban developments. This is the most flexible of the basic units.

<u>Unit of Construction</u> = <u>90m^2</u> = 12m x 7.5m.

The surface of this unit has been set on the gross average area of what is considered as an appropriate average apartment. The average apartment23 does not necessarily correspond to a specific type. It is designed to satisfy the need of an average household of 4.5 people[12]; accordingly, it is set between the size of an apartment with two-bedrooms (net surface: 64m^2, gross surface: 80m^2) and one with three-bedrooms (net surface: 80m^2, gross surface: 100m^2).

Gross surface area of 90 m^2 includes about 25% for structure and walls, as well as semi-public space such as entry, access staircase and corridor, etc. The higher the building, the larger semi-public space is necessary to access the apartments. Net surface area (72 m^2) includes the living room (20-25 m^2) the cooking space (5 m^2), the bedroom(s) (10 m^2 to 16m^2) the bathroom(s) (4m^2) and the circulation (10-20%). These types are expected to be the most frequent (41 and 42%)[13], as shown in Exhibit 22.

TYPE	%	NET m^2	GROSS m^2	HH SIZE
Four bedrooms	11%	96	120	11 +
Three-bedrooms	42%	80	100	5-10
Two-bedroom	41%	64	80	2-4
One-bedroom	6%	48	60	1

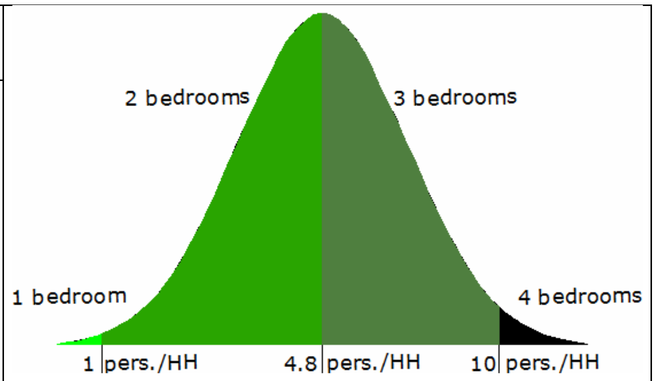


Exhibit 22. Dwelling Units

The length and width of the construction unit (12m x 7.5m) is given as an indication, and it has been chosen to constrain as little as possible the creativity of the architects[14]. Other dimensions (Ex. 15m x 6m, or 10m x 9m) are also acceptable.

2.2.2 Density

Density is calculated as floor to area ratio (FAR) and is measured in <u>m^2 of construction area at all floors in all buildings in a plot, per m^2 of land of the plot.</u>

[12] Kigali Conceptual Master Plan, Exhibit 4.2, p.64. This assumption, as all concepts of this discussion, is made in view of the 2020 vision. The intermediate steps will probably present higher average households and the temporary occupation of one dwelling by more than one households. The gradual improvement od the economic situation will progressively drive the occupation toward the norm.

[13] The respective frequency of one- two- three- four-bedrooms apartment is given indicatively and does not have influence in the calculation of the parameters, whereas the size of the average apartment does.

[14] A dwelling unit 7.5m deep can have façades on both sides. Two dwelling units 6m deep back to back can compose a building 12m deep.

As stated above the spread of the City must be curbed, but excessive crowding could crush the capability of the people to live a decent life and to build and improve their own dwelling. Consequently, only densities within upper and lower limits are considered, for the following reasons:

a) Extremely low densities (close to $0m^2/m^2$) are found in rural areas with sparse isolated one-family houses. Very low densities can be found as well in urban residential areas with luxury villas, or in spontaneous urban settlements in steep or marshy land.

b) Extremely high densities (in excess 1.5 m^2/m^2, up to 10 m^2/m^2 or even more) can be found in particular cities across the world; it is usually the result of situations in which the cost of the land is the most important factor, and it results in highly crowded housing. In Rwandan cities it should be considered as an exception, as far as pure housing is concerned.

The following densities have been considered:

Low density: 0.5 m^2/ m^2.
(Maximum 48 Dwelling Units per Hectare)
It is a density which allows one-storey construction. Buildings are of 1, 2, 4 and 8 storeys.

Medium density: 1 m^2/ m^2.
(Maximum 96 Dwelling Units per Hectare)
It allows developments of two-storey apartments in which families can still live in one "slice" of space from ground up. Buildings are of 2, 4, 8 and 12 storeys.

High density: 1.5 m^2/ m^2
(144 Dwelling Units per Hectare)
Height allowed: 4, 8, 12 and 16 storeys.

2.2.3 Heights

As shown above, for a given density not any number of storeys is allowed. With this taken into account, discrete building heights (1-2-4) have been selected, that are to become probably the most frequent sight in Kigali, for the following reasons.

–One storey. Apartments are contiguous to each other, with some open space –court or garden, or both– belonging to each family.

–Two storeys. Same as previous, but with two-level apartments. Beyond this height,
typologies with apartments from ground
up, though still possible, would be less
practical.

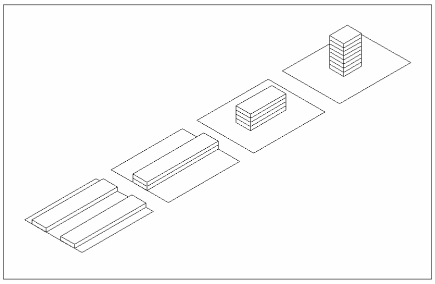


Exhibit 23.Four plots at low density.

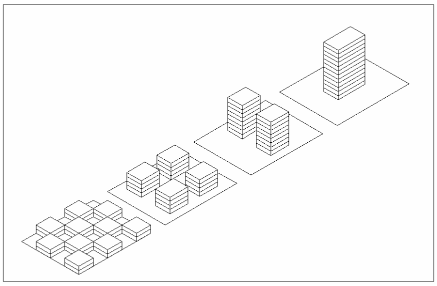


Exhibit 24.Four plots at medium density.

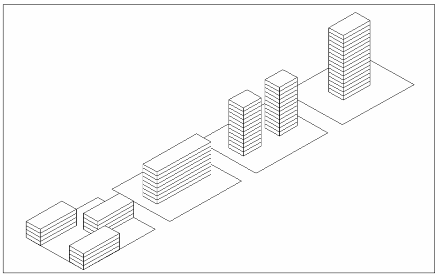


Exhibit 25.Four plots at high density.

–Four storeys. This is the maximum allowed height with one staircase. However five–storey buildings without elevator should also be allowed. Up to this level, simple and cheap construction techniques can be applicable. It is noteworthy that in the above density figures, 4-storey buildings are the only present at each density.

–Eight storeys. Once an elevator becomes necessary, it demands to be re-paid by rising at sufficient height. Further, this number of storeys is the maximum which should still allow the collapsible ladders of the fire department to reach the highest windows in case of fire; as a consequence, less stringent security regulations can still be allowed, such as single elevator and staircase.

–Twelve storeys. This is frequently used in low-cost housing operations across the world, where land is expensive. It requires two staircases and two elevators.

–Sixteen-storeys. It is the height allowed by the high density considered as acceptable of 1.5 m^2/ m^2. (At lesser densities the surface of a single floor would be insufficient for more than two apartments, and it wouldn't be worth it). Beyond sixteen storeys, at least three elevators would be required.

The reciprocal ranges allowed by the proposed density/height model, and the maximum number of dwellings that can be built on one hectare of land, are shown in Exhibit 26:

	NUMBER OF STOREYS					
	1	2	4	8	12	16
HIGH DENSITY (1.5 m2/ m2)	NO	NO	**144 DU/Ha**	**144 DU/Ha**	**144 DU/Ha**	**144 DU/Ha**
MEDIUM DENSITY (1 m2/ m2)	NO	**96 DU/Ha**	**96 DU/Ha**	**96 DU/Ha**	**96 DU/Ha**	NO
LOW DENSITY (0.5 m2/ m2)	**48 DU/Ha**	**48 DU/Ha**	**48 DU/Ha**	**48 DU/Ha**	NO	NO

Exhibit 26. Proposed density/height model.

As far as housing is concerned, there is no ground for promoting a widespread use of multi-storey apartment buildings above four storeys. As it has been showed above, acceptably high densities can be reached without them. However, rare 8, 12 or 16-storey would punctuate the urban landscape with recognizable landmarks, and could therefore bestow special character to different neighbourhoods.

Technical limits to the height of the buildings are pushed farther every few years, for the greater prestige of the builders and of the countries. The latest planned high-rise will be 1000 m tall (about 300 storeys). Less spectacular, but still impressive high-rise buildings are the most common sight in cities like Singapore and Hong Kong, where every square meter of land is precious (Exhibit 30). However, the concentration of people and activities puts considerable strain on traffic and all urban functions.

It must be stressed that the number of storeys specified above is considered as uniquely dedicated to housing. Nonetheless, other functions, such as shops, offices etc. are not only acceptable but requested, since they make the city more rich and lively. Urban space is made by the encounter, confrontation and blending of different activities. Functions should not be constrained by their container, but respond to the solicitations of the immediate context and wider environment.

Exhibit 27. Hong Kong" Housing:
10 m^2/m^2, 770 DU/Ha. Height:32 storeys

As a general principle, the higher the building, the less residential it should be. An apartment building of up to four storeys is OK, but a sixteen-storey should have a range of functions going –bottom to top– from the most public (commercial) to the semi-public (offices) to the private (apartments). In general, one-, two- and four-storey can have apartments directly from the ground level, while taller buildings should have it free.

Many city councils allow the developers "extra volume" at the top, provided that the ground level is enlivened by shops, restaurants and leisure space; this is a rule that deserves to be adopted.

2.2.4 Simulations

This section deals with simulated sites of low, medium and high density, with a fixed number of dwellings (770, for about 3500 people) in order to give a visual idea of what results the application of different densities could give in the urban space, and make them comparable. In FIGURE 3.2.5 the size of the three sites (all of them containing 770 average apartments and sheltering about 3,500people), are compared. The *variable* is the land requirement at each density, as follows.

Low density "site" (0.5 m^2/ m^2 maximum 48 DU/Ha): surface area of 138,240 m^2 (**13.8 Ha.**)

Medium density (1.0 m^2/ m^2, maximum 96 DU/Ha): surface area of 6912 m^2 (**6.9 Ha.)**

High density (1.5 m^2/ m^2, maximum 144 DU/Ha): surface area of 4,608m^2 (**4.6 Ha.)**

Two caveats must be kept in mind:

a) These are *pre-architectural* illustrations, with the quantitative function of uniquely depicting the volumes. The actual design might eventually take totally different aspects, provided that it remains within the maximum and minimum height allowed.

b) As stated above, for the purpose of this exercise only housing is taken into account, leaving for further planning all other necessary infrastructure and commercial, administrative, education and health services, etc.

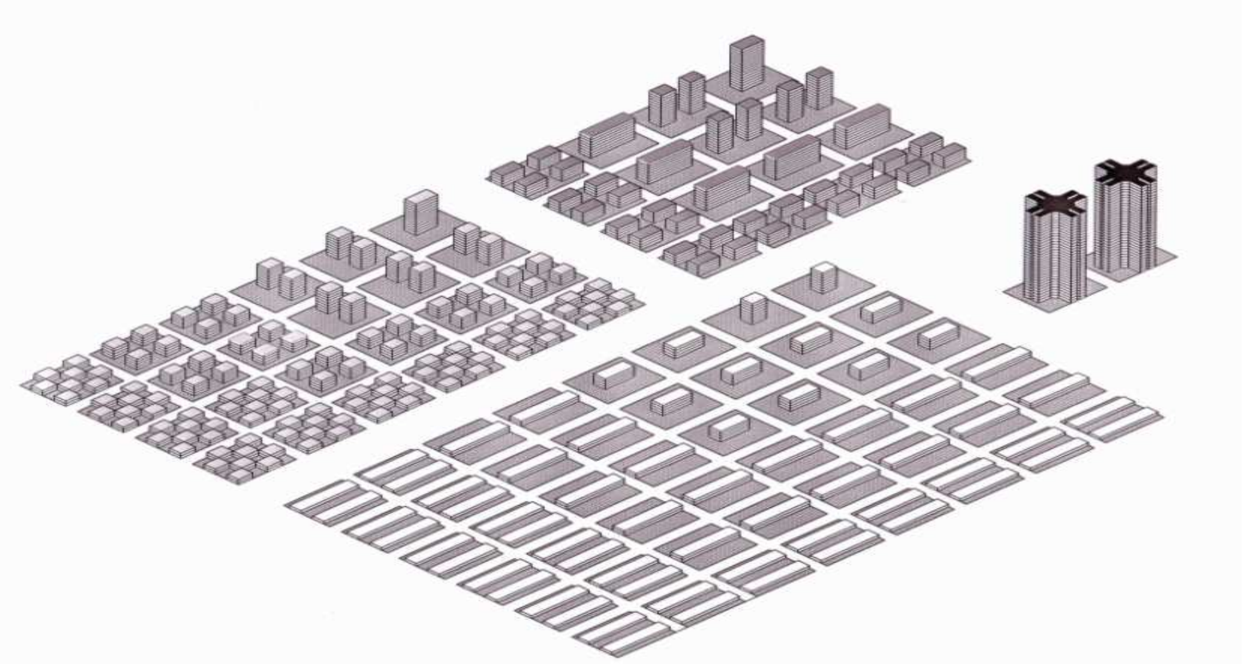


Exhibit 28. Three "sites" at low *(bottom)*, medium (*left*) and high (*top*) density with 770 dwelling units for 3500 people. The "Hong Kong housing" also contains the same number of dwellings and people.

2.2.5 Recommended Site Planning Criteria

The density of the sites to be developed is a function of their spatial relations with the City as a whole, and of the consequent cost of land. The height of the buildings in each plot will be decided by the city administrators as a function of the morphology of the plots and the constraints of the urban environment, without altering the density, and therefore the minimum required volume of construction, within the plot. As a guiding principle, the lowest density compatible with the sprawl-fighting constraints should be sought, and conversely the concern for better living conditions should privilege the lowest practicable rise within the targeted density

Variety is an essential factor of the quality of habitat at neighbourhood scale, and of the urban landscape at global scale. The height of the building should be linked to the urban context: quiet residential areas for large families tend to have one or two– maximum four–storey buildings, occupying most of the land and leaving less space open to the public.

More dynamic areas attracting shops and offices should have available more external space dedicated to the circulation of people and cars. Keeping the plots small and differentiated, with various building height, should allow giving to local urban scenes their individuality. Also, small operations (indicatively: 20 to 40 dwellings) are easier to implement, since the critical mass of investment and number of prospective buyers are within reach of more developers. Even in richer economies, ambitious plans often wait for years to take off, while the same volume of construction in smaller fractions could have been built earlier.

Various typologies naturally target different strata of the population, and therefore architectural variety would naturally preserve the intense cross relationships between families of different income that is currently observed in Kigali; spatial planning should carefully avoid introducing social segregation.

The percentage of plots to be allocated to each type depends on the strategy adopted for the best use of the limited financial resources available, either to the Government or to the users. However, the guiding concept should be: multi-storey for higher income, lower height for lower income. This may seem partially at odds with what could be expected to happen spontaneously, should the typology choices be left to mere economics. Many examples of cities come to mind, where the rich part of the population lives in cosy green neighbourhoods, while poorer families are packed in eight to twelve-storey buildings with minimum space in between.

The results are generally rather shabby everywhere and they would be even less sustainable in the Rwandan environment, because of high construction and maintenance costs. Indeed, the Master Plan urges a planning policy in contrast with the spontaneous trend:

In fairly addressing social equality, it should be noted that recommendations are for densities, not for standing. Many times there is a correlation existing development between standing and densities, with the highest densities hosting the lowest standing buildings and serving the poorest portion of the population. Designations here for density are intended to be separated from this historic relationship and recommendations will provide minimum levels of service to all portions of the population. There is a real opportunity through conscious planning to eliminate some of the factors contributing to social inequality[15].

The main basis for the allocation of houses to the low income sections and apartments to higher income sections of the population is that apartments require condominium fees and higher monthly expenditures for energy. Medium to high-level salaries, such as civil servants, traders, professionals, etc. are more likely to afford in-door cooking[16], decently maintained semi-public spaces, possibly elevators, which require buildings constructed by qualified contractors and more sophisticated and expensive construction techniques. People belonging to this income tier are more mobile, both geographically and socially, and they might plan to buy a house later and consequently look for apartments for rent. Besides, at higher education level, they are likely to be familiar with the "western" way of living, now adopted by elites in emerging economies around the world. Young intellectual would have spent student years in dormitories, in Rwanda or abroad; therefore the shift to a roomier apartment at the N°th floor would seem desirable. The young arising medium class should therefore lead the way in the shift from houses to single-family to apartments. The others will follow suit soon enough; young people are getting quickly wired nowadays.

Regarding the urban quality of the construction, it is foreseeable that houses belonging to a single family will be better maintained and improved. Provided that the starting level leaves space for evolution, this type is likely to look progressively better with the passing of time, contrary to the slow decay of others. People are proud of the look of their home, less of a public building.

In conclusion, we expect that the winning formula should be: low rise housing fits better low income families, while moderately high rise would be more acceptable by high income families, and both should be present in a well balanced development. Neighbourhoods designed according to this principle could be able to check slum sprawl and promote social mixing and ascension in the social status. From the architectural point of view, this ordered variety could help avoiding the opposite traps of disorienting chaos and depressing uniformity.

[15] KCMP, A1.5.3

[16] See discussion about charcoal and electricity as cooking fuel at numeral 1.2: Kigali Today, note 2.

2.2.6 Recommended Typology

In view of the above, it is advisable that each site of a significant size should contain:

Type A: Plots occupied by row houses of one or two storey built in assisted auto-construction by families of low income (rural labourers, informal sector vendors and labourers, small business owners, etc.);

Type B: Plots occupied by row houses of one or two storeys built by small contractors for families of low to medium income (young professionals, small business owners, mid-level government officials, private sector–white collar, military personnel–junior level, entrepreneurs–informal and formal sector);

Type C: Plots occupied by four storey multi-apartment houses for families of medium to high income (senior civil service and military officers, expatriates, Diaspora, wealthy Rwandese, businessmen and entrepreneurs –formal sector).

Higher rise buildings (more than four storeys), which can only target high-income families, should be considered as an exception.

The precise meaning of low, medium and high income is spelled out in the ***Kigali Housing Demand Forecast Model***, a comprehensive implementation mathematical framework which, in addition, details the different evolutionary phases.

It should be noted that there is no sharp distinction between types, especially the first ones (Type A and Type B) precisely because this is an evolutionary model, allowing each type to be increased and improved into the following type with the passing of time. The reciprocal rate of dwellings belonging to each type is also predicted to evolve with time: at the beginning the largest part will be of the lower kind, and the percentage of the higher kind will progressively increase. Cities --all of them-- grow in the course of decades —and centuries— with unequal bursts and consolidations. They have horizontal expansion phases and vertical densification phases, a sort of respiration in which each neighbourhood has its own rhythm. Kigali is no exception, which is undergoing densification in Nyarugenge, while planning expansion in Kicukiro. However, what in the past occurred by slow stratification, in the incredibly fast urbanization of our times must be planned and controlled; otherwise it will go the same way as Bangkok, Lagos, etc. with huge destitute suburbs.

2.2.7 Construction Techniques and Costs

The third main parameter: construction techniques and costs, is basically dependent on two major factors: height of the buildings and quality of the finishing. A range of costs per m^2 will be given as a function of those factors.

By and large, there are the following broad alternatives in the choice of construction techniques.

Temporary (walls of mud bricks, roofs of sticks and corrugated sheets, floor of cement screed). It can be used only for one-storey houses. It is the only technique that the poorest tier of the population can afford at the beginning, but it has the advantage of being easily demolished and progressively replaced with more permanent structure in the course of the time. Therefore it should be accepted for auto-construction –within fence walls built in permanent material, screening the house from the street.

Innovative techniques using local materials. Example: *Hydraform* interlocking dry-stacking blocks of soil with 12% of cement compressed in a machine, used mainly in South-Africa, but also in Kenya. As the previous, so far the technique has been used in Rwanda in few cases with mixed results. However, this could be due to poor application; if correctly operated this technique could be used at least up to two storeys, and it is advertised to resist even mild earthquakes[17]. The block making machine can be used either for *Hydraform* or for classic hollow blocks. Other innovative techniques are examination and experimentation in several laboratories (Kicukiro, KIST) and some of them have reached the prototype stage. However, the research is still at the beginning, and there is no guarantee that substantial cost reduction for low cost housing could result from it in the short term.

Hybrid[18]: load bearing walls of sand and cement hollow blocks, reinforced concrete tie-columns and ring-beams. It is used for buildings up to six floors. The Rwandan builder community (engineers, informal and formal contractors) is still wary, for load bearing walls, of the shift to cement-sand concrete blocks, due to the availability at low price, until 2005, of the noble material of burned bricks, which are since then proscribed because environment un-friendly. However, hollow blocks are the material most widely used for walls all over the world, wherever the cost of cement is reasonable, provided that is correctly applied. In the largest Kenyan cities for example, the hybrid technique is almost exclusively used in contractor-built housing. The cost of the construction of this kind is so profitable that it becomes a major factor in the choice of the type

[17] The seismic loading and design standards to be applied to Kigali are set in the Building Control Regulations referred to at numeral 1.3 (p.13)

[18] This technique is called hybrid because it combines load bearing masonry with reinforced concrete (RC) frame construction. It consists in concrete hollow blocks and vertical and horizontal RC members confined within the masonry, with reduced cross section. Components: blocks, RC tie columns and ring-beams, RC floor slabs plinth bands and foundations.

preferred by the developers; indeed, most new housing in Nairobi is made of 5-6 storey apartment buildings.

Exhibit 29. *Hydraform* Technique (from the Firm's catalogue.)

Exhibit 30. Hybrid Technique. National Housing Corporation, Nairobi,

<u>Reinforced concrete frame</u>, in which walls have no load-bearing function. This is the standard technique, by far the most widely used around the world for housing purposes. RC frame construction is often considered compulsory beyond four storeys.

Waiting for more sustainable techniques to become available, economy of common materials: cement and steel, could keep costs at reasonable levels. Not enough cement is produced in Rwanda, and the quality/cost conditions are favourable to imported brands. This issue is being addressed by the competent authorities, and hopefully will result in significant reduction of costs of RC. Meanwhile, since cement is not an environment friendly material, all expedients should be considered to reduce its use, such as the *Hydraform* and Hybrid techniques proposed above. Steel is mostly imported as well; however, reinforcement made of recycled scrap steel is available from Uganda and Rwanda. Its strength is about one-fourth of that of regular steel; however, if used cautiously in tie-column and ring beams, where there is no significant traction effort, this second-class steel might be acceptable, subject to careful scrutiny of the structural calculation. It cannot be used, however, in frame beams and to tie the roof to the structure, though, because it breaks under strong traction.

Within the considered construction techniques, the construction cost factor can be summarized as shown in Exhibit 31.

ITEM	<u>Low cost</u> (assisted auto-construction)		<u>Medium cost</u> (two to four storey houses)		<u>High cost</u> (five to sixteen storey apartments)	
	RwF/m^2	%	RwF/m^2	%	RwF/m^2	%

I. DIRECT COST	**38,338**	**74%**	**120,728**	**69%**	**333,576**	**64%**
1. Land	168	0%	168	0%	8,340	2%
2. Site Development	4,520	9%	4,520	3%	5,480	1%
3. Building	33,650	65%	116,040	66%	319,756	62%
3.1 Structure	30,610	59%	74,610	43%	207,826	40%
3.2 Finishing	3,040	6%	41,430	24%	111,930	22%
II. INDIRECT COST	**13,235**	**26%**	**54,528**	**31%**	**183,667**	**36%**
4. Professional Services	1,917	4%	9,055	5%	25,018	5%
5. Building Permit	200	0%	200	0%	200	0%
6. Financial (During Building Time)	5,367	10%	21,127	12%	58,376	11%
7. Sales & Marketing	0	0%	0	0%	16,679	3%
8. Developer Margin	5,751	11%	24,146	14%	83,394	16%
Total	**51,573**	**100%**	**175,256**	**100%**	**517,243**	**100%**

Exhibit 31 Cost Structure.

The *safety* of the construction becomes a prime concern in construction above four storeys and those open to the public. At present, the compliance with building safety standards is not adequate, and insurance is not compulsory. The task of setting rules and control their compliance is huge, and cannot be accomplished only by Government agencies. In European countries, the contractors must subscribe a **ten year warranty**, covering all safety risk. To deliver such certificate, the contractor must seek the control, from design to supervision, tests and completion, by a restricted number of certified engineering firms. These are large multi-competence companies (hundreds of engineers) and could also provide the necessary training of Rwandan technical staff to the respect of international construction standards[19]. The cost of the warranty is included in the high standard cost structure in Exhibit 35.

[19] Examples: NHBC in the United Kingdom, VERITAS in France, TETRATEC in Belgium …

The construction *quality* factor is less dependent in the way the foundations structure and roof is built, than in the finishing: doors and windows, plumbing, electrical and mechanical installations. At present, good components and qualified labour in these fields are to be obtained only in constructions made by international contractors. However, the situation is not stagnant, both internationally and nationally. The suppliers from around the world will gradually improve, in the medium term perspective, the quality of the materials available. Meanwhile, as the results of the active Rwandan policy in technical training will bear fruit, local contractors will be able to rely on skilled technicians in all fields, applying the adequate standards in all house installations. What cannot be achieved as yet will be commonplace tomorrow.

Finally, keeping high the quality of the architecture depends on the same factor as keeping the costs low: *competition*. These two objectives –aesthetics and economy– can be pursued simultaneously through national or international competitive bidding. Architects and contractors can present joint bids, which is a prevalent formula, even for modest operations. The spread of the information through the web allow a large number of talented groups to participate, and the City's administration will have the painstaking but fruitful work to choose the winner among the best architects allied with the least expensive contractors. The usual procedure is to evaluate the offers on the qualitative merit first, and then select the financial offer of the lowest bidder within a close quality range of the best.

2.2.8 Typology Model

The typology model is not exclusively spatial. It is substantiated socially by the results of the ***Focus Group Discussions***, and economically by the ***Kigali Housing Demand Forecast Model***, which are both part of this study. It demonstrates that the vision of the Master Plans is necessary and possible. What follows is a schematic depiction of the proposed types, which could somehow be the starting point of the expansion of Kigali.

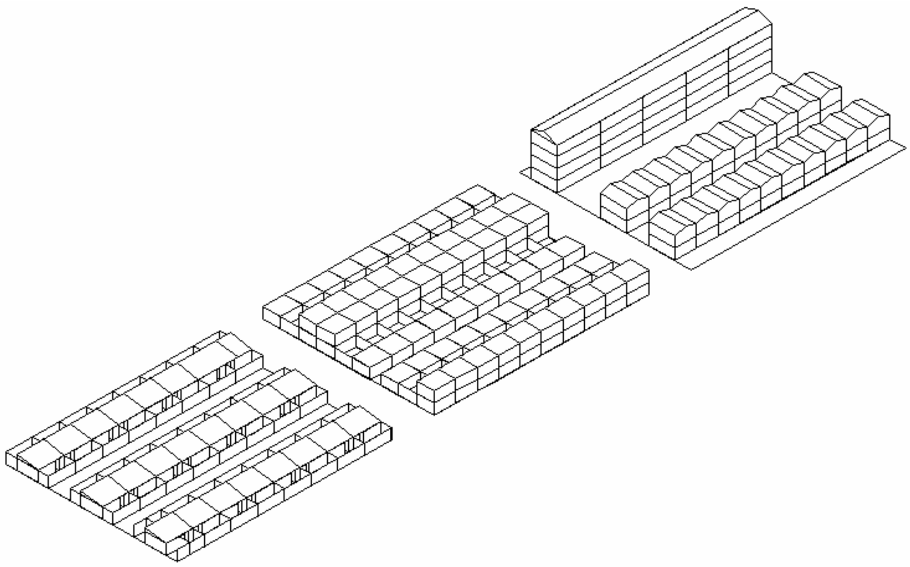


Exhibit 32. Types A, B (row houses) and C (apartments). Surface: 1 hectare. Total number of dwellings: 94. Initial FAR: 0.6. Final FAR: 0.8

Construction is a collective endeavour. The evolutionary model could only develop along different paths for different neighbourhoods, each conserving, as a spatial memory, its own characters and adopting its own architectural organization.

3. CONCLUSIONS AND RECOMMENDATIONS

Typology should combine the concerns of the urban planner to build a well-functioning, compact city, with those of the architect to respect minimum design standards of decent housing. Hence the following recommendations.

About existing habitat:

- Whenever possible, informal settlements should be either upgraded or re-built with safer techniques. Where relocation is inevitable, it should be made towards redevelopment areas where adequate housing for ex-informal dwellers is part of a combined typology.

About new habitat:

- As a guiding principle, the highest density compatible with the concern for acceptable living conditions should be sought.

- The building blocks of new developments should be small operations, each containing a variety of types, targeting all income segments.

- Low rise housing fits better low income families, while moderately high rise should be more acceptable by high income families, and both should be present in a well balanced development.

- The housing type adopted for the lowest income segments should be one/two-storey row-houses built step by step by auto-construction.

- The type adopted for low-medium income should be one/two-storey row houses built with low-cost techniques by local contractors, also gradually enlarged and improved.

- The type adopted for medium-high income segments should be four/five-storey apartment buildings.

- Higher rise buildings (more than five storeys), which can only target high-income families, should be considered as an exception.

- Construction techniques should cut back the use of cement and steel by innovative techniques, such as *Hydraform,* or by Hybrid techniques, combining load bearing walls and reinforced concrete tie-columns and ring-beams.

- For the control of the safety risk of buildings above five storeys and those open to the public, the introduction of a compulsory ten year warranty, with the caution of internationally certified engineering firms, should be considered.

- International competitive bidding, preferably of the turn-key formula for joint ventures of architects and contractors, should be routinely used for housing operations.

ANNEXES

ANNEX 1: ROW HOUSES IN HISTORY

European cities have grown during the last thousand years following different patterns of development, depending on the geographical and topographical settings and economic asset. However, the actor of this growth has been everywhere the middle class of artisans, traders, entrepreneurs who had come to the urban life to flee the grip of the rural servitudes imposed by the feudal owners of the countryside. They found in the cities opportunities to improve their social status and their life. Indeed, there was a popular saying: *the air of the city makes people free*. These people took advantage of the proximity to build economic links and synergies between different activities and services. They needed, but also they wanted, to live in a compact habitat, where many single-family houses were also a workshop or a shop. The type of houses inhabited by these low and medium class of active people were row houses, built in an amazing variety of styles and patterns, different form region to region of Europe –and later in America– and evolving in the course of the centuries. The examples selected below are precious remnants of this old times, which have been preserved up to the present times, though sometimes transformed by different uses than the original. They are witnesses of the past life in the following cities:

- Venice in the XIII century.
- Paris in the XVI century.
- Amsterdam in the XVII century
- London in the XVIII century
- New York in the XIX century.

Venice, Calle del Paradiso. The overhang of the first and second floor allows more space for street activities.

Venice, Corte Sconta. The rainwater was harvested from the roofs and the pavement of the yard and carefully filtered to the bottom of the well. Today, laundry is washed in machines, but the old system is still in use for the drying.

Paris, Place des Vosges. The neighbourhood is called Le Marais (the Marsh). It was inhabited by the lowest class in the middle-ages, and remained poor and rundown until a few decades ago. Today is among the most beautiful and richest part of the city.

Amsterdam, Herrengracht. The heart of the city is build on a concentric pattern of canals. The gable houses have large windows to take advantage of the northern light. At times façades are still narrower than in the picture (two windows). The stairs are often very steep, to use a minimum of internal surface.

London, “crescent” in Kensington. After the great fire that destroyed London in 1666, the reconstruction was organised by the architect Sir Christopher Wren in the neo-classic style. A significant part of the housing was made on this model. Many crescents have an enclosed garden in the middle, of which only the inhabitants have the key.

New York, “brownstones” in Brooklyn. To own one is the dream of all families in the city. Typically they have an independent basement, while the two- or three-storey main house is accessible from a short stair (“the stoop”). There is a garden in the back.

ANNNEX 2: RWANDA'S TRADITIONAL HOME

The typical home of a monogamous family has four elements that are always present:

RUGO (front yard)

INZU (hut)

IGIKARI (back yard)

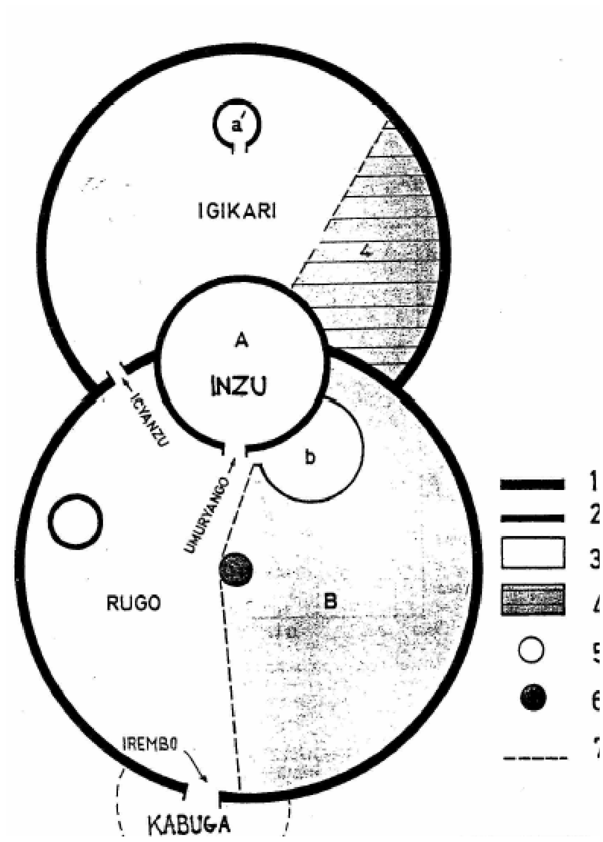
KABUGA (threshold)

RUGO is also the general name of the home. INZU has a "bombshell" shape and the various parts of its compact internal space are carefully characterized and outfit.

LEGEND

1. Living hedge (Ficus or Euphorbia)
2. Reed Walls
3. Huts: a' (Ancestors)
   A (Parents)
4. Small garden
5. Hoard
6. Fire (whose smoke relieves the cattle from insects)
7. Reed Fence

B. Cattle
b. Calves



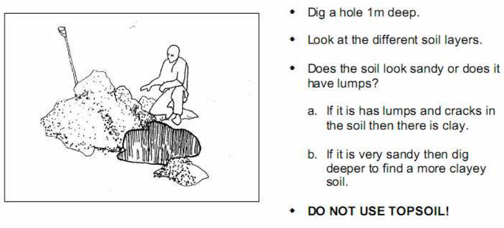
PLAN OF THE RUGO

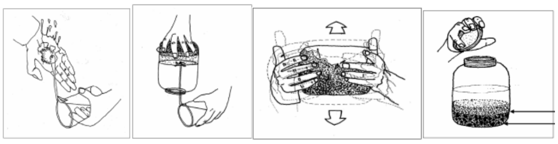
The basic plan depicted above could be extended and made more complex in the following circumstances: polygamy, marriage of the son (during six month after the wedding), high social status.

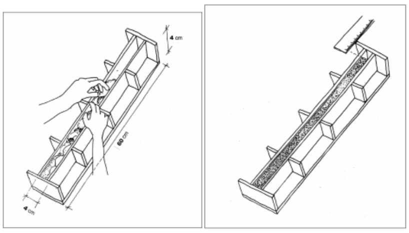
ANNEX 3: HYDRAFORM

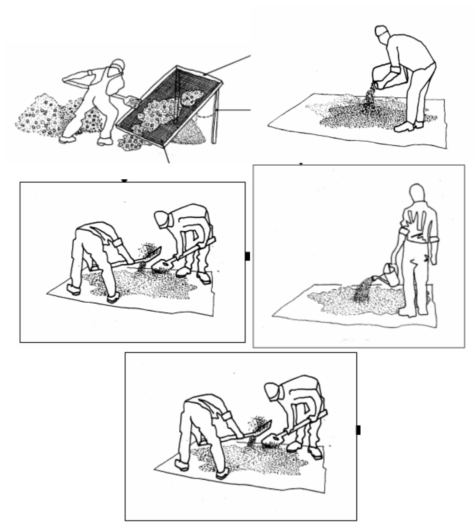
From the Firm's brochure

- FLY ASH OR SOIL AS RAW MATERIAL FOR MAKING BLOCKS.
- NO BURNING OF BRICKS.
- ECO FRIENDLY INTERLOCKING CONSTRUCTION.
- NO MORTAR NO PLASTER.
- LOW EMBODIED ENERGY-MINIMAL CEMENT.
- THERMALLY EFFICIENT USING LOW ENERGY FOR HEATING/COOLING.
- RE-USABLE MASONRY.


Dig a hole 1m deep.
Look at the different soil layers.
Does the soil look sandy or does it have lumps?
a. If it is has lumps and cracks in the soil then there is clay.
b. If it is very sandy then dig deeper to find a more clayey soil.
DO NOT USE TOPSOIL!







ANNEX 4: HYBRID TECHNOLOGY

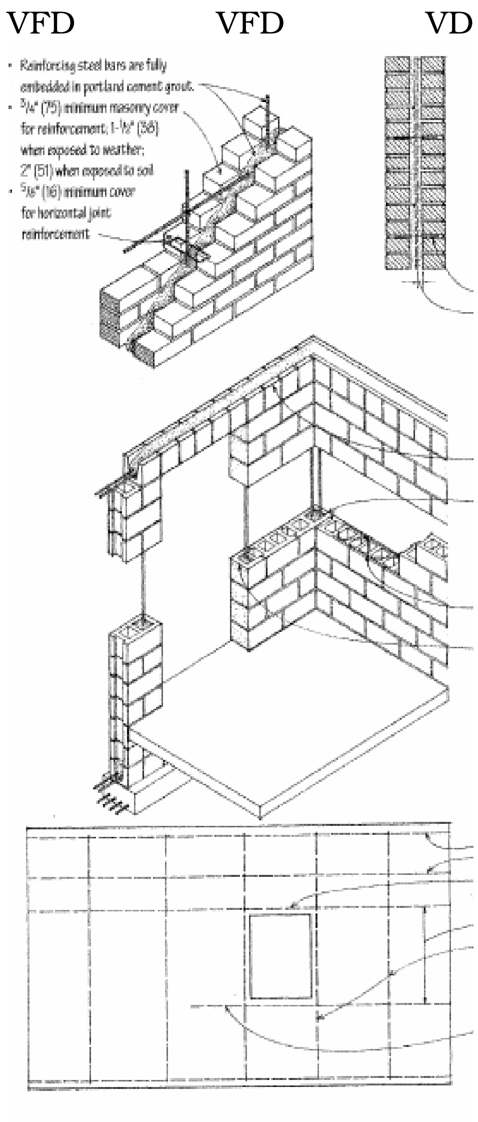
From the Manual

Building Construction Illustrated

Fourth Edition

Francis D.K. Ching

John Wiley and Sons, INC



From the Manual

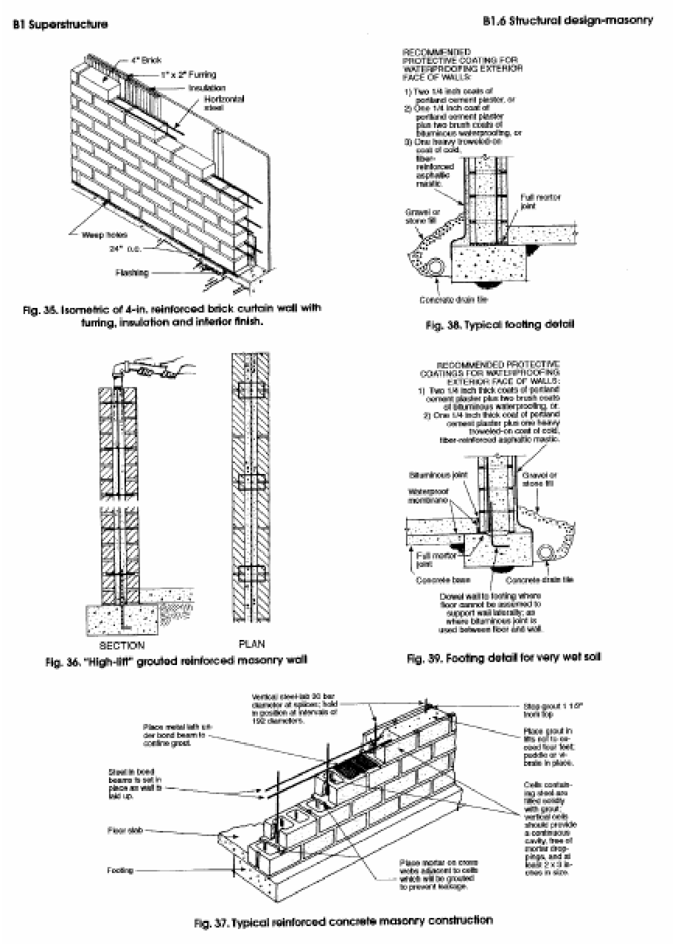
Time-Saver Standards for Architectural Design Data

Seventh edition

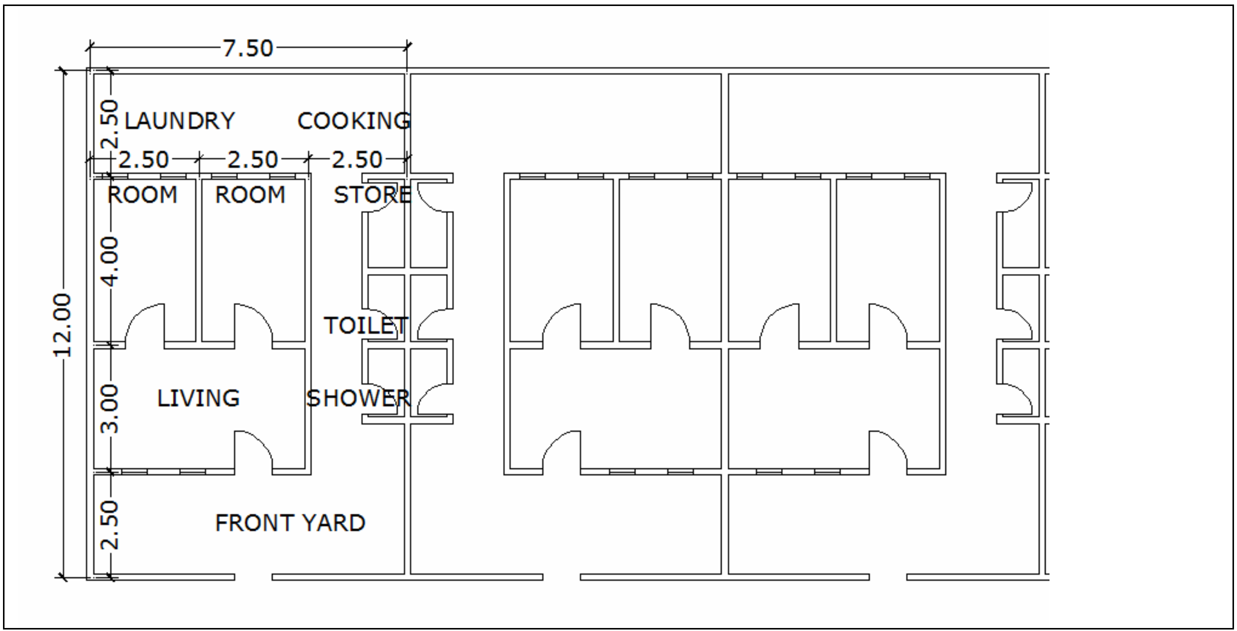
The Reference of Architectural Fundamentals

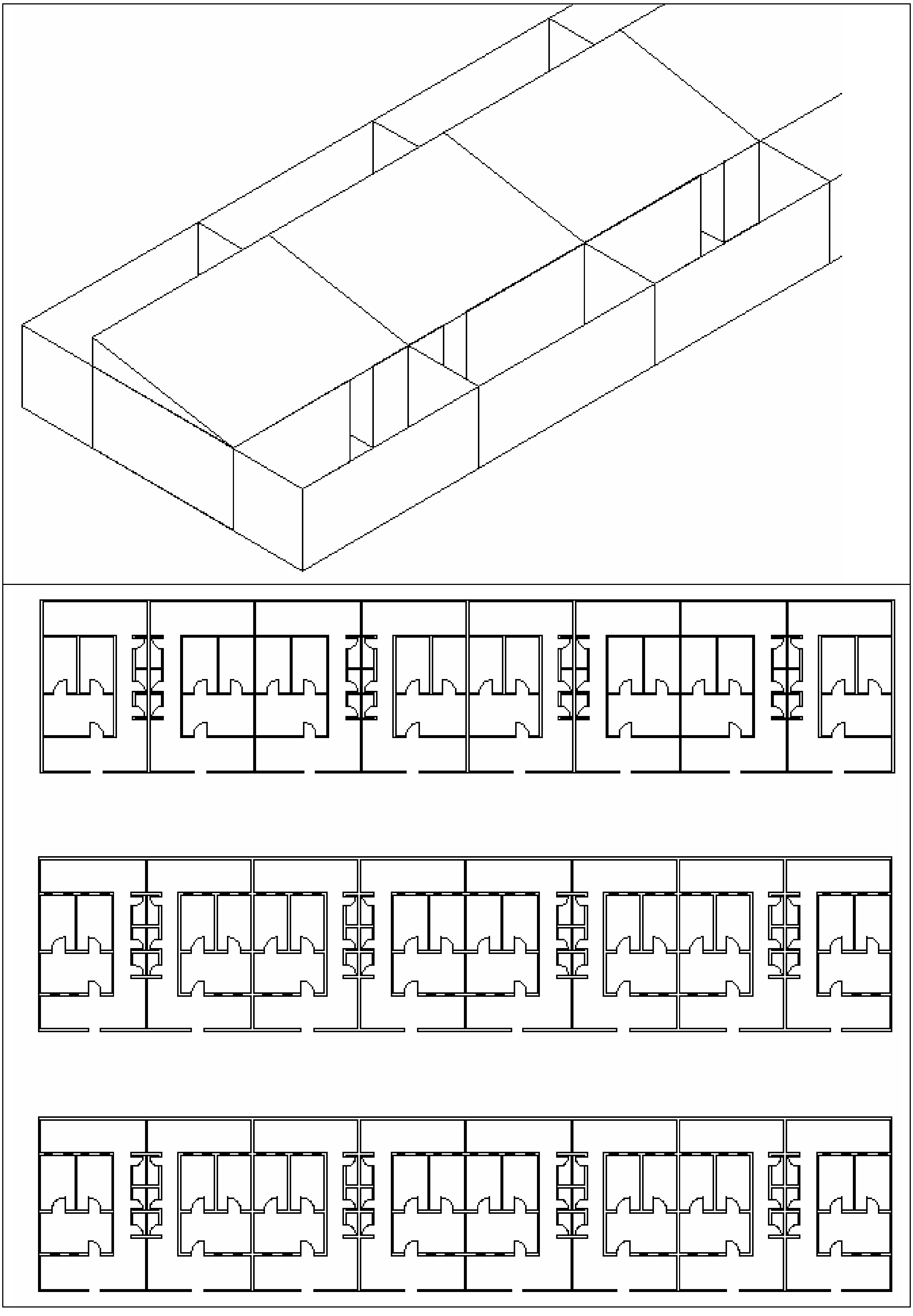
Donald Watson, FAIA, editor-in-chief
Michael J. Crosbie, Ph.D., senior editor

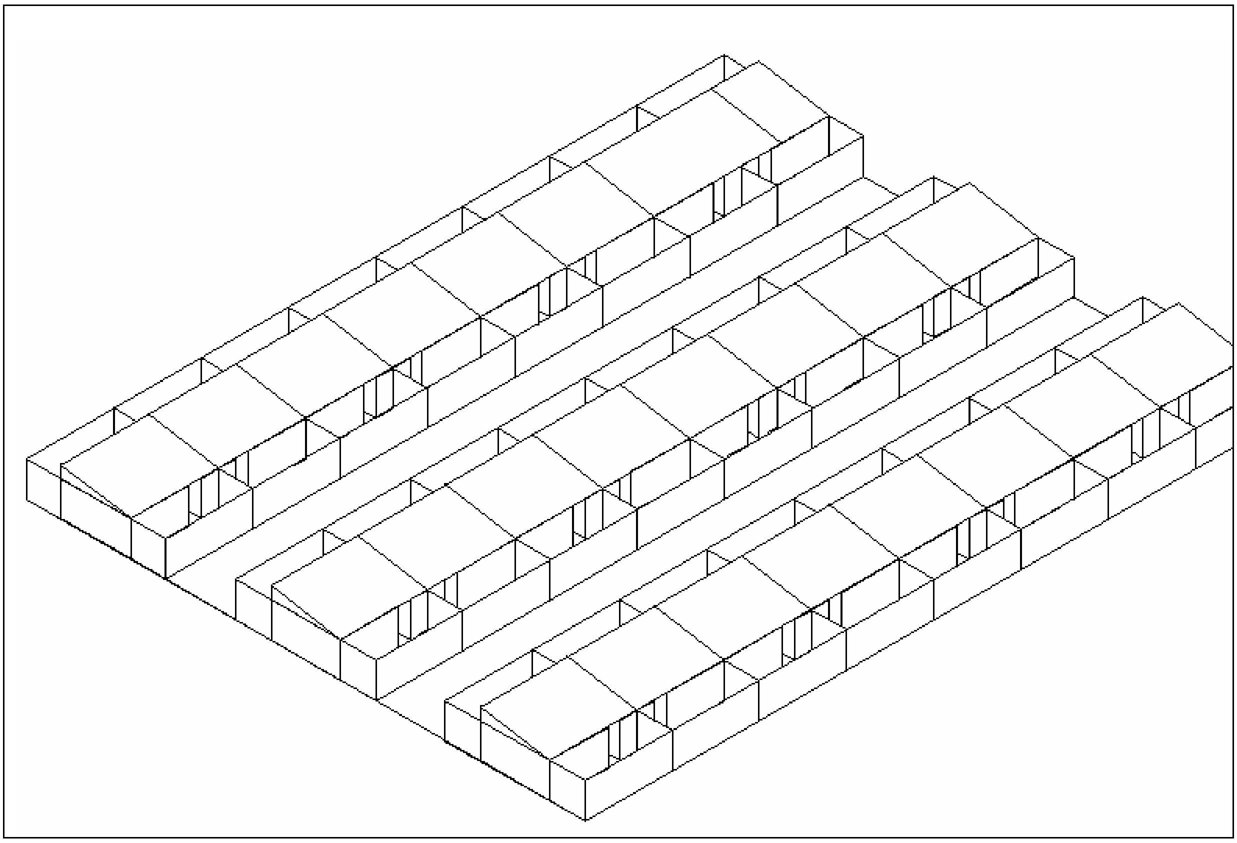
John Hancock Callender in memorium
associate editors



ANNEX 5: ILLUSTRATIVE EXAMPLE OF TYPE A1



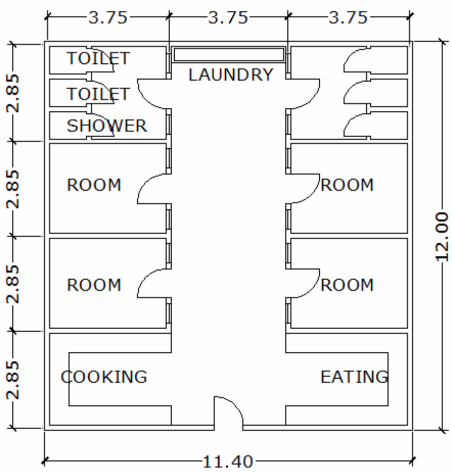




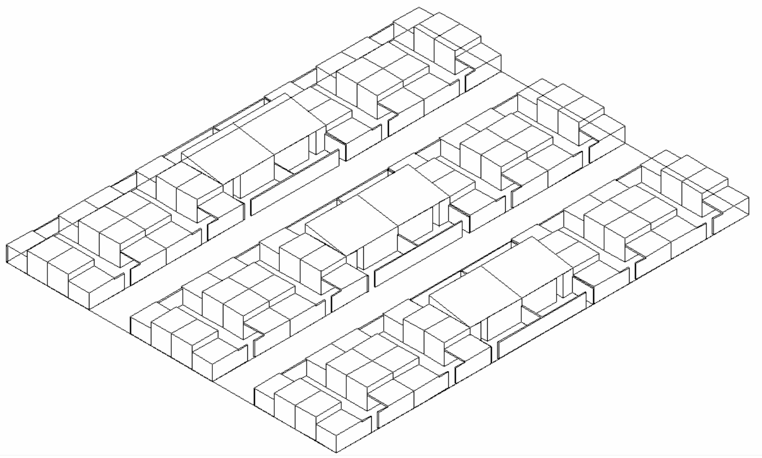
ANNEX 6: ILLUSTRATIVE EXAMPLE OF RENTAL COMPOUND

Many poor households in Kigali live in rental rooms with shared sanitary facilities.

The following Type A3 compound could somehow improve their living space.



Schematic Plan of A3 Type Compound with four Rental Rooms.



Conceptual Layout of a Plot Comprising twelve A3 and six ("Poor Landlord") A1 Types.

***

ANNEX 7: COST ESTIMATION TYPE A1 (Type A, excluding labour costs)

Nº	Description (Works descriptions)	Unites (Units)	Quantites (Quantities)	Prix Unitaires	Prix Totaux (Total Price)
0	**ACQUISITION PARCELLE (LAND COST)**				
	Terrain 12 x 7.5	m2	90,00	168	15.120
	S/Total : Terrain (land)				**15.120**
I	**TRAVAUX PRELIMINAIRES (PRELIMINARIES WORKS)**				
1,1	Installation de chantier (Site instalation)	ff	1,00	50.000	50.000
1,1	Nivelllement (Levelling (plot dimensions: 12.5 x 13,5 m)	m3	27,00	-	
1,2	Fouilles de fondations (Excavation of foundations trenches)	m3	total	-	
	S/Total : Preliminary works				**50.000**
II	**BETON (CONCRETE WORK)**				
2,1	Beton de proprete (Blinding concrete)	m^3	total	40.000	23.010
2,2	Chape en ciment sur fondation (Screed cement on foundation)	m^3	total	40.000	15.340
	S/ Total: Concrete				**38.350**
III	**MASONNERIES (STONEWORK AND BLOCWORK)**				
3,1	Maconneries en moellons au mortier de ciment (Foundations in stone masonaries with cement mortar)	m^3	0,00	32.500	349.668
3,2	Feutre asphaltique (Asphalt sheet)	ml	m2	1.000	46.900
3,3	Elevation en briques de terres compressees (Elevation in compressed earth bricks)	m^2	0,00	1.850	191.771
3,4	Linteaux en madriers de bois	ml	13,20	2.000	26.400
3,5	Claustras d'aeration (Vantilations blocks)	pc	20,00	500	10.000
	S/ TOTAL : Masonary works				**624.739**
IV	**STRUCTURE EN BOIS SCIE ET COUVERTURE (STRUCTUARAL WOODWORK AND ROOFING)**				
4,1	Toles galvanisees (galvanized sheet) 32 BG	m^2	60,00	2.500	150.000
4,2	Charpente en bois scies (strusses in wood) 6.5 ml	pc	1,00	13.000	13.000
4,3	Charpente en bois scies (strusses in wood) 7.5 ml	pc	2,00	13.000	26.000
4,4	Pannes et rampants (purlins and rafters)	ml	84,50	800	67.600
4,5	Planches de rives en bois (Fascia Board)	ml	15,00	1.000	15.000
4,6	Gouttieres en PVC (Gutters in PVC)	ml	7,50	2.500	18.750
4,7	Tuyaux de descentes en PNVC 110(Rainwater drainage pipe PVC DN 110)	ml	3,00	2.500	7.500
	S/ TOTAL:STRUCTURAL WOODWORK AND ROOFING				**297.850**

Continuation Annex 7…

V	**PORTES ET FENETRES (DOORS AND WINDOWS IN WOOD)**				
5,1	Portes a planchettes (Doors)	pc	3,00	25.000	75.000
5,2	Portes a planchettes avec impostes et ventilations (Doors with lovers)	pc	3,00	25.000	75.000
5,3	Fenetres a planchettes (Windows)				
	70 x 90	pc	6,00	11.000	66.000
	S/ TOTAL: DOORS AND WINDOWS				**216.000**
VI	**REVETEMENTS DES MURS (WALL FINISHING)**				
6,1	Enduits interieur au mortier de ciment (Plastering of interior walls)	m²	0,00	1.600	234.576
6,2	Enduits exterieurs au mortier de ciment (Plastering of external walls)	m²	0,00	1.500	31.860
	S/ TOTAL: WALL FINISHING				**266.436**
VII	**PAVEMENT ET CHAPE (PAVING AND FLOOR FINISHINGS)**				
7,1	Sous pavement int et ext en beton sur herissons de moellons (Concrete oversite on stone paving)	m²	61,34	1.600	98.144
7,2	Chape interieure en ciment (Interior smooth cement screed)	m²	53,84	1.600	86.144
7,3	Smooth cement screed on the sidewalks	m²	7,50	2.500	18.750
7,4	Plinthe en ciment (Skirting board in cement)	ml	52,40	1.000	52.400
	S/ TOTAL :PAVING AND FLOOR FINISHINGS				**255.438**
VIII	**PLOMBERIE ET SANITAIRES (PLUMBING INSTALLATION)**				
8,0	Raccordement au reseau Rwasco(Connection on the water supply network RWASCO)	ff	1,00	50.000	50.000
8,1	Tuyauterie d'alimentation (Distribution pipes)	ff	1,00	15.000	15.000
8,2	Tuyauterie d'evacuation (Discharge pipes)	ff	1,00	15.000	15.000
8,3	WC	pc	1,00	40.000	40.000
8,4	Douche (Shower)	pc	1,00	35.000	35.000
8,5	Accessoires de toilette (Toilet accessoiries (toilet roll holder, soap dish, towel rail, mirrors))	ff	1,00	10.000	10.000
8,6	Regards de visite (Inspection chambers)	pc	3,00	4.000	12.000
8,7	Fosse septique 10 usagers (Septic tank 10 users)*	pc	1,00	75.000	75.000
8,9	Puits perdus (Soakpit)*	pc	1,00	35.000	35.000
8,10	Citerne en plastic 1m3	pc	1,00	200.000	200.000
8,11	Puisard	pc	1,00	10.000	10.000
	S/ TOTAL :PLUMBING INSTALLATION				**497.000**

Continuation Annex 7…

IX	**INSTALLATION ELECTRIQUE (ELECTRIC INSTALLATION)**				
9,0	Raccordement au reseau RECO(Connection on the main cable RECO)	ff	1,00	40.000	40.000
9,1	Cablage et tubage (Wiring, junction and connection boxes)	ff	1,00	50.000	50.000
9,2	Distribution box	pce	6,00	500	3.000
9,3	Point lumineux fluorescents 40 w(fluorescent light fitting)	pce	2,00	4.000	8.000
9,4	Point lumineux avec ampoule a ionisation (Tubular compact fluorescent light fitting)	pce	7,00	1.000	7.000
9,5	Prises (electrical socket outlet)	pce	3,00	2.500	7.500
9,6	Interrupteurs (switch)	pce	8,00	2.500	20.000
	S/ TOTAL: ELECTRICITE				**135.500**
X	**PLAFOND (CEILING)**				
10,1	Plafond en panneaux multiplex sur giatage en bois (Ceiling in multiplex boards on a wooden structure)	m²	52,50		
	S/ TOTAL: PLAFOND				
XI	**PEINTURE ET VERINS (PAINTING AND VERNISH WORKS)**				
11,1	Peinture acrylique sur murs (Acrylic painting on walls)	m²	0,00		
11,2	Peinture sur huisseries en bois (Painting on doors and windows)	m²	30,24	1.200	36.288
	S/ TOTAL: Peinture et vernis				**36.288**
XII	**CLOTURE (FENCE)**				
12,1	Fouilles de fondations (Excavation of foundations trenches)	m^3	5,03	-	
12,2	Fondations en moellons au mortier de ciment (Foundation in stone masonaries joined with cement mortar)	m^3	4,02	32.500	130.650
12,3	Chape en cient (Cement screed on the foundation)	m^3	0,17	40.000	6.700
12,4	Maconneries en briques de terres compressees (Masonaries in compressed earth bricks for fence)	m2	28,48	1.850	52.679
12,5	Portail en tole metallique (Gate in metallic sheets on wood structure)	pc	1,00	20.000	20.000
12,6	Enduits sur cloture (Fence finishing)	m2	56,95	1.200	68.340
	S/ TOTAL: FENCE				**278.369**
	TOTAL				**2.711.089**

ANNEX 8: COST ESTIMATION TYPE A2 (Type A, including labour cost)

Nº	Description (Works descriptions)	Unites (Units)	Quantites (Quantities)	Prix Unitaires	Prix Totaux (Total Price)
0	**ACQUISITION PARCELLE (LAND COST)**				
	Terrain 12 x 7.5	m2	90,00	168	15.120
	S/Total : Terrain (land)				**15.120**
I	**TRAVAUX PRELIMINAIRES (PRELIMINARIES WORKS)**				
1,1	Installation de chantier (Site instalation)	ff	1,00	100.000	100.000
1,1	Nivelllement (Levelling (plot dimensions: 12.5 x 13,5 m)	m3	27,00	1.000	27.000
1,2	Fouilles de fondations (Excavation of foundations trenches)	m3	13,81	1.500	20.709
	S/Total : Preliminary works				**147.709**
II	**BETON (CONCRETE WORK)**				
2,1	Beton de proprete (Blinding concrete)	m^3	0,58	45.000	25.886
2,2	Chape en ciment sur fondation (Screed cement on foundation)	m³	0,38	45.000	17.258
	S/ Total: Concrete				**43.144**
III	**MASONNERIES (STONEWORK AND BLOCWORK)**				
3,1	Maconneries en moellons au mortier de ciment (Foundations in stone masonaries with cement mortar)	m^3	10,76	40.000	430.360
3,2	Feutre asphaltique (Asphalt sheet)	ml	46,90	1.100	51.590
3,3	Elevation en briques de terres compressees (Elevation in compressed earth bricks)	m²	103,66	2.214	229.503
3,4	Linteaux en madriers de bois	ml	13,20	2.100	27.720
3,5	Claustras d'aeration (Vantilations blocks)	pc	20,00	600	12.000
	S/ TOTAL : Masonary works				**751.173**
IV	**STRUCTURE EN BOIS SCIE ET COUVERTURE (STRUCTUARAL WOODWORK AND ROOFING)**				
4,1	Toles galvanisees (galvanized sheet) 32 BG	m²	60,00	3.000	180.000
4,2	Charpente en bois scies (strusses in wood) 6.5 ml	pc	1,00	16.000	16.000
4,3	Charpente en bois scies (strusses in wood) 7.5 ml	pc	2,00	16.000	32.000
4,4	Pannes et rampants (purlins and rafters)	ml	84,50	1.000	84.500
4,5	Planches de rives en bois (Fascia Board)	ml	15,00	1.200	18.000
4,6	Gouttieres en PVC (Gutters in PVC)	ml	7,50	3.000	22.500
4,7	Tuyaux de descentes en PNVC 110(Rainwater drainage pipe PVC DN 110)	ml	3,00	3.000	9.000
	S/ TOTAL:STRUCTURAL WOODWORK AND ROOFING				**362.000**

Continuation Annex 8…

V	**PORTES ET FENETRES (DOORS AND WINDOWS IN WOOD)**				
5,1	Portes a planchettes (Doors)	pc	3,00	30.000	90.000
5,2	Portes a planchettes avec impostes et ventilations (Doors with lovers)	pc	3,00	30.000	90.000
5,3	Fenetres a planchettes (Windows)				
	70 x 90	pc	6,00	14.000	84.000
	S/ TOTAL: DOORS AND WINDOWS				**264.000**
VI	**REVETEMENTS DES MURS (WALL FINISHING)**				
6,1	Enduits interieur au mortier de ciment (Plastering of interior walls)	m²	146,61	2.000	293.220
6,2	Enduits exterieurs au mortier de ciment (Plastering of external walls)	m²	21,24	1.800	38.232
	S/ TOTAL: WALL FINISHING				**331.452**
VII	**PAVEMENT ET CHAPE (PAVING AND FLOOR FINISHINGS)**				
7,1	Sous pavement int et ext en beton sur herissons de moellons (Concrete oversite on stone paving)	m²	61,34	2.000	122.680
7,2	Chape interieure en ciment (Interior smooth cement screed)	m²	53,84	2.000	107.680
7,3	Smooth cement screed on the sidewalks	m²	7,50	3.000	22.500
7,4	Plinthe en ciment (Skirting board in cement)	ml	52,40	1.200	62.880
	S/ TOTAL :PAVING AND FLOOR FINISHINGS				**315.740**
VIII	**PLOMBERIE ET SANITAIRES (PLUMBING INSTALLATION)**				
8,0	Raccordement au reseau Rwasco(Connection on the water supply network RWASCO)	ff	1,00	50.000	50.000
8,1	Tuyauterie d'alimentation (Distribution pipes)	ff	1,00	15.000	15.000
8,2	Tuyauterie d'evacuation (Discharge pipes)	ff	1,00	15.000	15.000
8,3	WC	pc	1,00	40.000	40.000
8,4	Douche (Shower)	pc	1,00	35.000	35.000
8,5	Accessoires de toilette (Toilet accessoiries (toilet roll holder, soap dish, towel rail, mirrors))	ff	1,00	10.000	10.000
8,6	Regards de visite (Inspection chambers)	pc	3,00	6.000	18.000
8,7	Fosse septique 10 usagers (Septic tank 10 users)*	pc	1,00	100.000	100.000
8,9	Puits perdus (Soakpit)*	pc	1,00	50.000	50.000
8,10	Citerne en plastic 1m3	pc	1,00	200.000	200.000
8,11	Puisard	pc	1,00	30.000	30.000
	S/ TOTAL :PLUMBING INSTALLATION				**563.000**

Continuation Annex 8…

IX	**INSTALLATION ELECTRIQUE (ELECTRIC INSTALLATION)**				
9,0	Raccordement au reseau RECO(Connection on the main cable RECO)	ff	1,00	50.000	50.000
9,1	Cablage et tubage (Wiring, junction and connection boxes)	ff	1,00	60.000	60.000
9,2	Distribution box	pce	6,00	500	3.000
9,3	Point lumineux fluorescents 40 w(fluorescent light fitting)	pce	2,00	4.000	8.000
9,4	Point lumineux avec ampoule a ionisation (Tubular compact fluorescent light fitting)	pce	7,00	1.000	7.000
9,5	Prises (electrical socket outlet)	pce	3,00	2.500	7.500
9,6	Interrupteurs (switch)	pce	8,00	2.500	20.000
	S/ TOTAL: ELECTRICITE				**155.500**
X	**PLAFOND (CEILING)**				
10,1	Plafond en panneaux multiplex sur giatage en bois (Ceiling in multiplex boards on a wooden structure)	m²	52,50		
	S/ TOTAL: PLAFOND				
XI	**PEINTURE ET VERINS (PAINTING AND VERNISH WORKS)**				
11,1	Peinture acrylique sur murs (Acrylic painting on walls)	m²	146,61		
11,2	Peinture sur huisseries en bois (Painting on doors and windows)	m²	30,24	1.400	42.336
	S/ TOTAL: Peinture et vernis				**42.336**
XII	**CLOTURE (FENCE)**				
12,1	Fouilles de fondations (Excavation of foundations trenches)	m^3	5,03	1.500	7.538
12,2	Fondations en moellons au mortier de ciment (Foundation in stone masonaries joined with cement mortar)	m^3	4,02	40.000	160.800
12,3	Chape en cient (Cement screed on the foundation)	m^3	0,17	45.000	7.538
12,4	Maconneries en briques de terres compressees (Masonaries in compressed earth bricks for fence)	m2	28,48	2.214	63.044
12,5	Portail en tole metallique (Gate in metallic sheets on wood structure)	pc	1,00	24.000	24.000
12,6	Enduits sur cloture (Fence finishing)	m2	56,95	1.400	79.730
	S/ TOTAL: FENCE				**342.649**
	TOTAL				**3.333.823**

ANNEX 9: COST STRUCTURE – 4 FLOOR HYBRID TECHNOLOGY

COST STRUCTURE KIGALI

ITEM	Low (*)		Medium (**)		4 floors Hydrid		4 floors RCF		High (***)	
	RwF/M2	%	RwF/M2	%	RwF/M2	%	RwF/M2	%	RwF/M2	%
I. DIRECT COST	**38.338**	**74%**	**120.728**	**69%**	**171.381**	**67%**	**264.505**	**67%**	**333.576**	**64%**
1. Land	168	0%	168	0%	8.340	3%	8.340	2%	8.340	2%
2. Site Development	4.520	9%	4.520	3%	4.520	2%	5.040	1%	5.480	1%
3. Building	33.650	65%	116.040	66%	158.521	62%	251.125	63%	319.756	62%
3.1 Structure	30.610	59%	74.610	43%	114.435	44%	171.690	43%	207.826	40%
3.2 Finishing	3.040	6%	41.430	24%	44.086	17%	79.435	20%	111.930	22%
II. INDIRECT COST	**13.235**	**26%**	**54.528**	**31%**	**85.891**	**33%**	**132.453**	**33%**	**183.667**	**36%**
4. Professionnal Services	1.917	4%	9.055	5%	12.854	5%	19.838	5%	25.018	5%
5. Building Permit	200	0%	200	0%	200	0%	200	0%	200	0%
6. Financial (During Building Time)	5.367	10%	21.127	12%	29.992	12%	46.288	12%	58.376	11%
7. Sales & Marketing	0	0%	0	0%	8.569	3%	13.225	3%	16.679	3%
8. Developer Margin	5.751	11%	24.146	14%	34.276	13%	52.901	13%	83.394	16%
Total	**51.573**	**100%**	**175.256**	**100%**	**257.272**	**100%**	**396.958**	**100%**	**517.243**	**100%**

					per m²
OPTION 1: LOW QUALITY FINISHING					**257.272**
OPTION 2: HIGH QUALITY FINISHING					**310.295**

ANNEX 10 - BENCHMARKING

1. CONSISTENCY AND COMPARABILITY OF THE MEASUREMENTS

The main parameters of the Typology Model proposed must be measured up to those prescribed in the planning documents: the Kigali Conceptual Master Plan, the Sub Area Schematic Plans (Rebero, Kinyinya, Kimihurura, Masaka) and the Detailed District Plans (Nyarugenge and Kinyinya**)** that are being enforced by the City of Kigali.

However, the Model is not a direct deduction from the Plans; if it were, it would afford no additional information. Only an independent research will confirm the validity of the Model as a tool for the implementation of the Plans.

The parameters of the plans are not always directly comparable. Some detailed analysis is needed to use them as benchmarks, for the following reasons.

1. The densities of the Master Plan and the Sub Area plans, whose thrust is mainly qualitative, are given in number of dwelling units per hectare (DU/Ha). A more operative tool for developers and architects should be the floor to area ratio (FAR) [20]. The FAR could be deducted from the DU/Ha data only if the average gross size of dwelling was known (by multiplying the number of dwellings by the average size and dividing by 10,000m^2-one hectare). However, the average size of the apartment is a difficult guess. The Master Plan mentions a *two-bedroom apartment* but warns that *this is only given as an example, so three or four bedrooms are also possible*; moreover, it gives a variable number of people per dwelling (3 to 5 in the Master Plan, only 3 to 4 in the Sub-area plans).

2. The densities of the **Master Plan** are not directly consistent with those of the Sub Area Plans; the former are, by far, lower than the latter (see the table below). An unknown corrective factor would be needed to make them comparable. Therefore, as a conservative precaution, only the recommendations of the Sub Area Plans are considered.

3. The **Sub Area Plans** of Rebero, Kinyinya, Kimihurura, Masaka give values for Medium-Low Density and Medium-High Density. If it is assumed that Medium Density means the mean value between "Medium-Low" and Medium-High", and the "Medium Low" density means the mean value between Low and Medium, the interpolation scale would turn out like this:

High:	**~200 DU/Ha**
Medium-High:	~140 DU/Ha
Medium:	**~105 DU/Ha**
Medium-Low:	~70 DU/Ha
Low:	**~35 DU/Ha**

[20] Means the gross floor area of the building or buildings at all floors on any plot divided by the plot area.

It is further assumed that the sign "~" should be interpreted as "*within 10% of*".

4. The **Detailed Master Plans** of Nyarugenge and Kinyinya Districts do not indicate the *average* number of dwelling unit par hectare, but prescribe the *maximum* floor to area ratio and the *maximum* height allowed[21], as follows:

Residential Single Family	**(R1)**
Maximum Floor to Area Ratio (FAR):	0.8 maximum
Maximum Number of Floors:	G+1
Mixed Single Family Residential	**(R1A)**
Maximum Floor to Area Ratio (FAR):	1.0 maximum
Maximum Number of Floors:	G+1
Rural Residential	**(R1B)**
Maximum Floor to Area Ratio (FAR):	0.8 maximum
Maximum Number of Floors:	G+1
Low Rise Residential	**(R2)**
Maximum Floor to Area Ratio (FAR):	1.4 maximum
Maximum Number of Floors:	G+4 (apartments)
Medium Rise Residential	**(R3)**
Maximum Floor to Area Ratio (FAR):	1.6 maximum
Maximum Number of Floors:	G+7 (apartments)
High Rise Residential	**(R4)**
Maximum Floor to Area Ratio (FAR):	2.4 maximum
Maximum Number of Floors:	G+15 (apartments

However, different standards are applied to the two Detailed Plans. All zoning categories and sub-categories are intended only for Nyarugenge District, in particular for the Central Business District. For Kinyinya District only Mixed Single Family (R1A) and Low Rise (R2) are proposed.

It must be stressed that the norms are not prescribed for *Density* but for *Rise*. Accordingly the norms for Residential Single Family (R1), and Rural residential (R1B) –the lowest– and the Mixed Single Family Residential (R1A) are much lower than the Low Rise norms, because they are limited to two storeys[22]. Low Rises in the Detailed Plans are combined with rather high densities. For example, the Low Rise (FAR: 1.4 max) is very close to the Medium Rise (FAR: 1.6 max) and is already explicitly planned for apartments.

5. In the proposed **Typology Model**, a range of values is given for the density parameters. The lowest values correspond to the minimum densities compatible

[21] There are other minor norms concerning setbacks, secondary buildings, etc. which are not reported here.

[22] Logically G+1 should not be the maximum, but the *minimum* height corresponding to FAR 1.0, which does not allow less than two storeys, but does allow much higher buildings.

with the number of storeys: 1, 2, 4 (maximum without elevator), 8 (maximum accessible from a fire department ladder) and so on, that are discussed in the report. They are proposed as *optimal*, but not as a straightjacket. Indeed, heights of 2, 5 (without elevator), 10 (with only one elevator), etc. are also acceptable, and correspond to the highest end of the range. Even higher densities are considered as acceptable only in exceptional cases.

2. COMPARISON TABLE

In the following table, density ranges allowed by the proposed Typology Model, as explained at point 5 above, are given both in DU/Ha and FAR. The Model's measures of density as DU/Ha are compared with those of the Sub-Area Plans —corrected for consistency as indicated at point 3 above; the measures of densities as FAR are compared with those of the Detailed Plans —except for the lowest densities R1, as explained at point 4 above.

	TYPOLOGY MODEL	**MASTER PLAN**	**SUB AREA PLANS**	**DETAILED PLANS**
HIGH DENSITY				**HIGH RISE (R4)**
FAR	1.5-1.8 m^2/m^2	/	/	max 2.4 m^2/m^2
HEIGHT	16-20 storeys	/	/	max G+15 (apts)
D.U./HECTARE	144-180 Du/Ha	(33-66 Du/Ha)	~200 DU/Ha	/
MEDIUM DENSITY				**MEDIUM RISE (R3)**
FAR	1-1.25 m^2/m^2	/	/	max 1.6 m^2/m^2
HEIGHT	8-10 storeys	/	/	max G+7 (apts)
D.U./HECTARE	96-120 Du/Ha	(11-33 Du/Ha)	~105 DU/Ha	/
LOW DENSITY				**LOW RISE (R2)**
FAR	0.5-0.6 m^2/m^2	/	/	max 1.4 m^2/m^2
HEIGHT	4-5 storeys	/	/	max G+4 (apts)
D.U./HECTARE	48-60 Du/Ha	(8-13 Du/Ha)	~35 DU/Ha	/

3. CONCLUSIONS

The Typology Model can only be compared separately with the Sub Area Plans and the Detailed Plans.

a) Comparison with the Sub Area Plans:

At *high density*, the Typology Model recommends densities/heights that stand within the acceptable range of the Sub Areas Plans.

At *medium density*, the Model is equal to the Sub Area Plans.

At *low density*, the Model recommends higher densities than the Sub Area Plans.

b) Comparison with the Detailed Plans.

The densities of the Typology Model are approximately in line with the Kinyinya District Plan, where is allowed only the so-called Low Rise, which actually corresponds to the whole range of densities of the Typology Model. The Medium and High Rise densities are present exclusively in the Detailed Master Plan of Nyarugenge District (the Central Business District and the centre of the City); these correspond to what the Typology model considers as exceptional densities.