MODERN BRICK CONSTRUCTION SYSTEMS
A Catalogue of Affordable Solutions Made in Rwanda

Construction costs starting from FRW 150,000 per m²
New solutions for challenging slope conditions
Featuring 12-in-1 garden houses for medium-high density locations
Introducing the Swiss Cube Typology System

THIRD EDITION
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PROECCO Promoting Off-Farm Employment through Climate Responsive Construction Material Production

SKAT Swiss Resources Centre and Consultancies for Development
FOREWORD

Ban Ki-moon, former Secretary General of the UN:

"Income generation is closely associated with housing; it includes payments to construction works and construction suppliers, as well as home-based activities, some of which are linked to the global chain of production."

"Housing makes a considerable contribution to the national economic development in a variety of ways, including increases in capital stock, fixed investment and savings. In addition, there are significant interactions with financial systems, through housing banks, mortgage schemes, interest rates and consumption of housing services."

Source: Foreword from Dr. Anna Kajumulo Tibaijuka’s Building Prosperity: Housing and Economic Development, 2009
Construction costs in Rwanda are higher than in most other countries in Africa. This is mainly due to its land-locked geographic position and the resulting high transportation costs of imported material, namely of steel and cement. Rwanda’s abundant clay deposits are of excellent quality and the massive demand of the country’s fast-growing cities are fertile grounds for the construction industry to produce and build with Modern Brick Technologies. For several years Rwandan SME’s, with the support of the Swiss Agency for Development and Cooperation, have started to produce machine-made Modern Bricks that allow for the construction of smart and cost-effective buildings. These technologies have the potential to significantly reduce the cost of housing and construction and bring tens of thousands of jobs back to Rwanda that were lost to the foreign cement industry.
REASON N° 1: MODERN BRICK WALLS ARE CHEAPER THAN TRADITIONAL BRICK OR CEMENT BLOCK WALLS

MODERN BRICKS ARE SEMI-INDUSTRIAL BRICKS PRODUCED BY RWANDAN ‘SMEs’

<table>
<thead>
<tr>
<th>Hand-moulded Cement Block Wall</th>
<th>Traditional Brick Wall Outside facing English Bond</th>
<th>Modern Industrial Brick Wall Fully Facing English Bond</th>
<th>Modern Semi-Industrial Brick Wall Fully Facing English Bond</th>
<th>Modern Semi-Industrial Brick Wall Fully Facing Rowlock Bond</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRW 15.500</td>
<td>FRW 15.500</td>
<td>FRW 21.500</td>
<td>FRW 14.000</td>
<td>FRW 9.500</td>
</tr>
</tbody>
</table>

BREAKDOWN OF MATERIAL COSTS PER SQUARE METER OF WALL (INCLUDING TAXES)

<table>
<thead>
<tr>
<th>Hand-moulded Cement Block Wall</th>
<th>Traditional Brick Wall Outside facing English Bond</th>
<th>Modern Industrial Brick Wall Fully Facing English Bond</th>
<th>Modern Semi-Industrial Brick Wall Fully Facing English Bond</th>
<th>Modern Semi-Industrial Brick Wall Fully Facing Rowlock Bond</th>
</tr>
</thead>
<tbody>
<tr>
<td>350 kg</td>
<td>206 kg</td>
<td>98 kg</td>
<td>98 kg</td>
<td>41 kg</td>
</tr>
<tr>
<td>0</td>
<td>121</td>
<td>121</td>
<td>121</td>
<td>101</td>
</tr>
</tbody>
</table>

REASON N° 2: MODERN BRICK MULTIPLEXES ARE CHEAPER THAN SINGLE-STORIED HOUSES

The Modern Brick Multiplex System is a standardised structural design for urban low-rise buildings, using RCC-reinforced Rowlock-Bond made of Modern Bricks. Its simple details are easy-to-apply and well-suited to medium-skilled masons who undergo a short training.

STRUCTURAL DESIGN DRIVES COST SAVINGS

- The S-size shell of a Modern Brick House Duplex (58m²), ready for interior works, costs FRW 6 mio
- A Modern Brick Duplex with 3 bedrooms costs less than FRW 10 mio (5 bedrooms: FRW 15 mio)
- Modern Brick Apartments can be built for less FRW 5 mio, Studios for less than FRW 3 mio
- A common plot can accommodate up to 12 duplexes, 14 simplexes or even 28 equipped studios!

The Modern Brick Multiplex is particularly attractive for landlords who dream of a modern urban house and want to offer their middle-income tenants a modern and affordable house, apartment or studio.
REASON № 3: LANDOWNERS CAN COMPOSE THEIR BUILDING BY SELECTING SIZES/STANDARDS THEY CAN AFFORD

BUILDINGS ARE ASSEMBLED FROM A CATALOGUE OF SIMPLEX, DUPLEX AND TRIPLEX UNITS

Overview of modern brick duplex sizes and related costs* and options on how they can be used.

<table>
<thead>
<tr>
<th>Size</th>
<th>Dimensions</th>
<th>Area</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>XXL</td>
<td>5.25m x 8.3m</td>
<td>86m²</td>
<td>2 x 43m²</td>
</tr>
<tr>
<td>XL</td>
<td>4.9m x 8.3m</td>
<td>81m²</td>
<td>2 x 41m²</td>
</tr>
<tr>
<td>L</td>
<td>4.6m x 8.3m</td>
<td>77m²</td>
<td>2 x 38m²</td>
</tr>
<tr>
<td>M</td>
<td>4.1m x 8.3m</td>
<td>67m²</td>
<td>2 x 33m²</td>
</tr>
<tr>
<td>S</td>
<td>3.78m x 8.3m</td>
<td>63m²</td>
<td>2 x 31m²</td>
</tr>
<tr>
<td>XS</td>
<td>3.5m x 8.3m</td>
<td>58m²</td>
<td>2 x 29m²</td>
</tr>
</tbody>
</table>

*Calculated based on a simple plot in Kigali context that include all installations as well as tax and profit. Land excluded.

REASON № 4: THE INTERIOR OF A MODERN BRICK MULTIPLEX CAN BE CUSTOMISED AND CHANGED OVER TIME

ROOMS + WALLS CAN BE BUILT INCREMENTALLY IN RESPONSE TO EVOLVING NEEDS

Overview of modern brick duplex sizes and related costs* and options on how they can be used.

2016
Neighborhood Services: Water & Electricity only
Tenant Profile: Shop Employees, Taxi Moto Drivers
Tenant Income per HH: 100,000 FRW/month
16 Studios @ 35,000 FRW/month (8 per floor)

2022
Neighborhood Services: Pathways / drainage channels
Tenant Profile: Drivers, Artisans
Tenant Income per HH: 200,000
8 Apartments @ 65,000/month (4 per floor)

2028
Neighborhood Services: Asphalt Road
Tenant Profile: Clerks, Junior Engineers, Shopkeepers
Tenant Income per HH: 400,000
4 Duplexes @ 130,000/month

2036
Neighborhood Services: Public Transportation
Tenant Profile: Civil Servants, Entrepreneur
Tenant Income per HH: 600,000
2 Rowhouses @ 200,000/month
REASON NO 5: MODERN URBAN BRICK MULTIPLEXES ARE SINGLE- PLOT SOLUTIONS FOR SMALL-SCALE LANDLORDS

ADAPTABLE TO ANY PLOT GEOMETRY, TOPOGRAPHY AND TENANT PROFILE

Adaptability
A standard plot size of 600 m² (20m x 30m) can accommodate a variety of duplex combinations (from rowhouses to apartment blocks), depending on the purchasing power of owners and tenants.

The flexible combination of units allows for optimized use of plot size, geometry and topography.

Sample 12-in-1 Building Configuration (left)
12-in-1 Stacked Duplex Solution
Estimated Construction Costs:
Starting from 96 million FRW

Sample 9-in-1 Building Configuration (below)
2 - Split-level back-to-back duplex
2 - Double Split-level duplex
1 - Split-level triplex (T*)
1 - Stacked split-level duplex
1 - Stacked Duplex
1 - Stacked Simplex
1 - Duplex
Estimated Construction Costs:
Starting from 92 million FRW

REASON NO 6: MODERN BRICK MULTIPLEXES ARE SUITABLE FOR SMALL NEIGHBORHOOD-LEVEL MICRO ESTATES

LANDOWNERS WHO JOIN HANDS TO UPGRADE THEIR ENVIRONS CAN FORMALISE THE BUILT ENVIRONMENT

78% of urban dwellings are in unplanned neighbourhoods and informally constructed due to the lack of affordable formal construction solutions. The formalisation of these neighborhoods becomes affordable through the Modern Brick multiplex housing solution.

Upgrading begins at the plot level with individuals or small groups of landowners without disrupting existing tenancy patterns. This method minimises the need for government intervention or expropriation.

Ideally, two or three neighbours would come together to create a small city block with the architectural and environmental qualities of a small estate with sufficient parking, walkways, private courtyards and a recognizable address.

Sample Neighborhood Development (right)
The flexibility of the Modern Brick Multiplex system allows for the design of a dense neighborhood, with a variety of house sizes, configurations and architectural expression, given rise to a truly mixed-use and mixed-income neighborhood.
**Reason No 7: Landlords Building Modern Urban Brick Multiplexes Can House Twice the Number of Tenants**

Modern brick multiplex houses are suitable for many different zoning designations.

50 Dwelling Units / Ha

60 Dwelling Units / Ha

120+ Dwelling Units / Ha

High-densities are achievable even on challenging and sloped terrains.

- **Reason No 8: Smart Densification Allows Small Landowners to Self-Finance Neighborhood Upgrading**

Land value in informal areas can be unlocked through compact affordable building solutions.

Irregular plot and building distribution

Typical Unplanned Settlement in Kigali

Built up area as shown totals 5000 m².

Existing building coverage is low

Study of building footprints reveals that less than 80% of land is occupied.

Storied houses can improve land use

Building an additional floor and compacting structures can free up land for development.

Compact development can unlock value of land

Available land can be sold to co-finance the in-situ resettlement of land owners and tenants into storied modern brick houses (left).

After self-financing, the floor area could be increased as per below.
**REASON No 9: MODERN BRICKS CAN BE PRODUCED BY LOCAL SMEs AND SUBSTITUTE IMPORTED CEMENT**

**PRODUCTION UNITS IN AND AROUND THE SECONDARY CITIES COULD RESPOND TO THE DEMAND FOR MATERIALS**

Even though the current production of Modern Bricks is still low, they can be - and, are - produced by existing small and medium-scale upgraded brickyards. 100 more could be upgraded and produce bricks for 3,000 houses per year. Given the annual demand of 40,000 - 50,000 new urban houses, 50 new medium-scale brick factories could profitably produce Modern Bricks to substitute the expensive and substandard traditional ones. In the case where houses currently made of imported cement would be built with Modern Bricks instead, up to 150 brick factories could operate profitably.

**Brickyard Type**

<table>
<thead>
<tr>
<th>Brickyard Type</th>
<th>XL Semi-Industrial</th>
<th>L Artisanal</th>
<th>M Artisanal</th>
<th>S Upgraded Tile Kiln</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Output</td>
<td>3,000,000 Bricks (100-350 houses)</td>
<td>1,000,000 Bricks (70-110 houses)</td>
<td>488,800 Bricks (40-70 houses)</td>
<td>300,000 Bricks (20-35 houses)</td>
</tr>
</tbody>
</table>

**New brickyards required for substituting:**

<table>
<thead>
<tr>
<th>A. Traditional Bricks</th>
<th>50 brickyards - or - 150 brickyards - or - 199 brickyards - or - 380 brickyards</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Cement Blocks</td>
<td>161 brickyards - or - 484 brickyards - or - 441 brickyards - or - 1,221 brickyards</td>
</tr>
</tbody>
</table>

**REASON No 10: LOCAL BRICKS GENERATE LOCAL JOBS AND INCREASE THE MEDIUM INCOME**

**SUBSTITUTING FOREIGN CEMENT WITH MODERN BRICK COULD GENERATE UP TO 20,000 CONSTRUCTION JOBS**

Current Situation
Concrete blocks are mostly composed of imported cement (Cimerwa production is sufficient for concrete work and mortar only). The capital spent for concrete blocks is mainly lost to the foreign cement industry and does not further circulate in the country or create local jobs.

Modern Bricks Replace Concrete Blocks
The introduction of 50 new modern brick facilities in proximity to Kigali and the secondary cities reduces the need for imported cement. With more production facilities in operation, the number of local jobs available in the building material and construction sector increases exponentially. The capital remains in-country, the job growth translates to higher demand.

The transformation of Rwanda’s brick industry will require targeted interventions and investments all along the value chain. The Swiss Agency for Development Cooperation has therefore mandated Skat Consulting to offer the following services to entrepreneurs, investors and technicians in the following areas:

- Site and Clay Analysis
- Business Design Support
- Access to Technologies + Skills
- Marketing Support
**THE SWISS CUBE SYSTEM IS SUITABLE TO MOST PLOT AND TERRAIN CONFIGURATIONS**

**HOW DOES IT WORK?**
The modular Swiss Cube system is completely flexible and inter-changeable, while maintaining one core principle: 1 house with road access and at least 1 private garden per family.

**STRETCH**
Extend or expand the cube to accommodate bigger families/budgets.

**SPLIT**
Maximize plot area by subdividing cube into smaller units.

**STACK**
Superimpose the cube to maximize plot development without sacrificing precious liveable area.

9 different split-level Swiss Cube configurations... can be stacked one on top of the other... and assembled into one volume...

**MULTIPLY**
Maximize plot development and reduce construction costs by sharing external walls and infrastructure services.

(Standard plot 20m x 30m)

Traditional plot developments are difficult to densify, especially on sloped terrains.

STRETCHED corner duplex houses are suitable for landlords or commercial spaces.

STACKED split-level simplex, duplex and triplex houses allow for increased density, height and luxury on sloped terrains.

**SPLIT ON A SLOPE**
Maintain private garden access by introducing split-level units.

**STACK ON A SLOPE**
Increase density by superposing one unit on another.

**ANATOMY OF A BUILDING**
Multiple units can be assembled on a standard plot without sacrificing basic amenities like direct road access and private gardens.

Creating an attractive urban multiplex...
<table>
<thead>
<tr>
<th>XXL SHELL</th>
<th>XXL DUPLEx</th>
<th>XXL SIMPLEX (1 unit per floor)</th>
<th>XXL STUDIO (2 units per floor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior Dimensions: 5.20m x 8.34m</td>
<td>Living Room/Dining Room 20</td>
<td>Living Room/Dining Room 17</td>
<td>Living Room/Dining 13</td>
</tr>
<tr>
<td>Room Height: 2.40m</td>
<td>Master Bedroom 10</td>
<td>Master Bedroom 10</td>
<td>Kitchen ✓</td>
</tr>
<tr>
<td>Walling Material: Fully Facing Modern Bricks</td>
<td>Additional Bedrooms (x4) 32</td>
<td>Additional Bedrooms (x1) 8</td>
<td>Bathroom ✓</td>
</tr>
<tr>
<td>Slab: Maxspan</td>
<td>Kitchen ✓</td>
<td>Kitchen ✓</td>
<td>Garden ✓</td>
</tr>
<tr>
<td>Flooring: Cement Screed</td>
<td>Bathroom ✓</td>
<td>Bathroom ✓</td>
<td></td>
</tr>
<tr>
<td>Roofing Material: Iron Sheet</td>
<td>Storage ✓</td>
<td>Storage ✓</td>
<td></td>
</tr>
</tbody>
</table>

**Flooring Areas:**
- **XXL SHELL:** 86m²
- **XXL DUPLEx:** 86m²
- **XXL SIMPLEX (1 unit per floor):** 43m²
- **XXL STUDIO (2 units per floor):** 21m²

**Prices (starting from):**
- XXL SHELL: FRW 10,200,000
- XXL DUPLEx: FRW 14,400,000
- XXL SIMPLEX (1 unit per floor): FRW 8,600,000
- XXL STUDIO (2 units per floor): FRW 4,200,000
L SHELL 77m²
Interior Dimensions: 4.63m x 8.34m
Room Height: 2.40m
Walling Material: Fully Facing Modern Bricks
Slab: Maxspan
Flooring: Cement Screed
Roofing Material: Iron Sheet

L DUPLEX 77m²
Living Room/Dining Room 20
Master Bedroom 10
Additional Bedrooms (x3) 24
Kitchen ✓
Bathroom ✓
Storage ✓
Garden ✓

Living Room/Dining Room 20
Master Bedroom 10
Additional Bedrooms (x3) 24
Kitchen ✓
Bathroom ✓
Storage ✓
Garden ✓

FRW 9,500,000
FRW 13,000,000

L SIMPLEX 38m²
Living Room/Dining Room 15
Master Bedroom 10
Additional Bedrooms 8
Kitchen ✓
Bathroom ✓
Storage ✓
Garden ✓

Living Room/Bedroom 14
Kitchen ✓
Bathroom ✓
Garden ✓

FRW 7,500,000
FRW 3,800,000 / unit

L STUDIO (1 of 2 units) 19m²

Level 0
Level 1

FRW 3,800,000 / unit

Starting from

Starting from

Starting from

Starting from

Level 0
Level 1

L Single Duplex
L Simplex
L Studio

Starting from

Starting from

Starting from

Starting from

Level 0
Level 1

L Single Duplex
L Simplex
L Studio

Starting from

Starting from

Starting from

Starting from

Level 0
Level 1

L Single Duplex
L Simplex
L Studio
M SHELL

Interior Dimensions: 4.06m x 8.34m
Room Height: 2.40m
Walling Material: Fully Facing Modern Bricks
Slab: Maxspan or Timber Floor
Flooring: Cement Screed
Roofing Material: Iron Sheet

M DUPLEX

Interior Dimensions: 4.06m x 8.34m
Living Room / Dining Room: 27
Master Bedroom: 9
Additional Bedrooms (x2): 16
Kitchen: ✓
Bathroom x1 (or x2): ✓
Storage: ✓
Garden: ✓

M SIMPLEX

Interior Dimensions: 3.33m x 8.34m
Living Room/Dining Room: 15
Master Bedroom: 9
Kitchen: ✓
Bathroom: ✓
Storage: ✓
Garden: ✓

M STUDIO (1 of 2 units)

Interior Dimensions: 3.33m x 8.82m
Living Room/Bedroom: 11
Kitchen: ✓
Bathroom: ✓
Garden: ✓

Starting from:

FRW 8,100,000

FRW 10,700,000

FRW 6,500,000

FRW 3,600,000 / unit
**S SHELL** 63m²

- Interior Dimensions: 3.78m x 8.34m
- Room Height: 2.40m
- Walling Material: Fully Facing Modern Bricks
- Slab: Timber Floor / Maxpan between units
- Flooring: Cement Screed
- Roofing Material: Iron Sheet

**S SINGLE SPLIT-LEVEL DUPLEX** 63m²

- Living Room / Dining Room: 20
- Master Bedroom: 9 - 11
- Additional Bedrooms (x2): 16 (or 7+7)
- Kitchen: ✓
- Bathroom (x2 or x3): ✓
- Storage: ✓
- Garden: ✓

**S SHELL** 63m²

- Interior Dimensions: 3.78m x 8.34m
- Room Height: 2.40m
- Walling Material: Fully Facing Modern Bricks
- Slab: Timber Floor / Maxpan between units
- Flooring: Cement Screed
- Roofing Material: Iron Sheet

**S SIMPLEX** 31m²

- Living Room / Dining Room: 13
- Master Bedroom: 8
- Additional Bedroom (x1): 8
- Kitchen: ✓
- Bathroom: ✓
- Storage: ✓
- Garden: ✓

**S DUPEX** 63m³

- Living Room / Dining Room: 19
- Master Bedroom: 10
- Additional Bedrooms (x2): 16
- Kitchen: ✓
- Bathroom (x1): ✓
- Garden: ✓

---

**Unit 1**

- Level 0
- Level 1

**Unit 2**

- Level 0
- Level 1

---

**FRW 7.500.000**

**FRW 10.500.000**

**FRW 5.000.000**

**FRW 9.500.000**
S SLOPE SPLIT LEVEL DUPLEX (Unit 1)  54m²
- Living Room/Dining Room  13.5
- Master Bedroom  9
- Additional Bedrooms (x2)  15 (or 6 +7)
- Kitchen  ✓
- Bathroom (x2)  ✓
- Storage  ✓
- Garden  ✓

Starting from FRW 9.000.000

S SLOPE SPLIT LEVEL TRIPLEX (Unit 2)  107m²
- Living Room/Dining Room  36
- Master Bedroom  10
- Additional Bedrooms (x3)  24
- Kitchen / Storage  8
- Bathroom (x3)  ✓
- Garden  ✓

Starting from FRW 18.000.000

S BACK-TO-BACK DUPLEX (1 of 2 units)  31m²
- Living Room/Dining Room  13
- Bedroom (1 or 2)  12
- Kitchen  ✓
- Bathroom (x1)  ✓
- Garden  ✓

Starting from FRW 6.000.000 / unit

S DOUBLE SPLIT-LEVEL DUPLEX (1 of 2 units)  54m²
- Living Room  16
- Master Bedroom  9
- Additional Bedrooms (x2)  16
- Kitchen  ✓
- Bathroom (x1)  ✓
- Garden  ✓

Starting from FRW 9.000.000 / unit

S Split-level Duplex and Triplex

S Back-to-Back

S Double Split-level Duplex
XS SHELL

Interior Dimensions: 3.50m x 8.34m
Room Height: 2.40m
Walling Material: Fully Facing Modern Bricks
Slab: Timber Floor / Maxpan between stacked units
Ground Floor Slab: Cement Screed
Roofing Material: Iron Sheet

XS SIMPLE DUPLEX

Interior Dimensions: 3.50m x 8.34m
Room Height: 2.40m
Walling Material: Fully Facing Modern Bricks
Slab: Timber Floor / Maxpan between stacked units
Ground Floor Slab: Cement Screed
Roofing Material: Iron Sheet

**Living Room/Dining Room**
**Master Bedroom**
**Additional Bedrooms (2x)**
**Kitchen**
**Bathroom (1x)**
**Storage**
**Garden**

Starting from FRW 7,500,000
Starting from FRW 9,200,000

XS STUDIO (1 of 2 units)

Living Room/Dining Room
Kitchen
Bathroom
Garden

Starting from FRW 2,900,000 / unit

XS DOUBLE SPLIT-LEVEL DUPLEX (1 of 2 units)

Living Room/Bedroom
Master Bedroom
Additional Bedrooms (x2)
Kitchen
Bathroom (x1)
Garden

Starting from FRW 8,000,000 / unit

XS Simple Duplex

XS Studio

XS Double Split-level duplex
The Kigali PSF Demonstration House introduces the "S.M.A.R.T. Tafali Etage" concept to the general public. Made entirely of local materials, it displays the potential of what the Rwandan construction industry would be capable of supplying on mass scale, if all relevant stakeholders, from the brickmaker to engineers and architects, worked together to address the high demand for quality, affordable construction for rapidly urbanizing districts, cities and towns.
Built in 2015, the Rusizi Modern Brick Duplex Shophouse serves as a testing/display unit for cost-effective housing solutions built of Modern Bricks. It also serves as a model for a mixed-use building for urban contexts.

Area: 117 m²
Unit Cost: FRW 20 million (basic finishes)
Cost includes all features except land and engineering. Profit and labor are included.
Cost per square meter: 206 USD

Elements Tested:
- RCC Reinforced Rowlock Bond Wall
- Timber Slab with Terracotta + Plastic Finish
- Timber Stairs
- Strawtec Partitioning Walls
AnnEx 1

RCC REINFORCED ROWLOCK BOND WALLING SYSTEM

ROWLOCK BOND: A TIME-TESTED CONSTRUCTION METHOD

Rowlock Bond walling is a cost-effective walling system for houses up to 2.5 stories. It was popular during the industrial revolution in both the UK and United States. In the last three decades, the system has made a resurgence in South Asia. A damage assessment after the Kathmandu Earthquake (Nepal 2015) proved the strength and good para-seismic performance of the Rowlock Bond walling system. The system has now been officially endorsed by the Nepalese government.

AnnEx 2

MODERN BRICK MULTIPLEX CONSTRUCTION SYSTEM

STRUCTURAL INTEGRITY ALLOWS FOR MAXIMUM FLEXIBILITY

The Modern Brick Multiplex Construction System is a "strong box" held together by concrete reinforcement (tie beams). The result is a structural frame within which flooring and walling elements can be adjusted and modified at will. All typologies are suitable for maxpan floor slabs, while the narrower models, M and S, can be outfitted with a timber floor. Both systems can be applied without modification to the structural "box."
Skat Consulting’s Comparative Construction Cost Calculator

204

Offers’ Average

Version 0.1 Date: 7th of July 2016 Author: dwy

6,061,406

- Design Option 2

Windows Living Room

Tie Beam

False Ceiling

m2

Triplex boards with supporting structure -

Triplex boards with supporting structure -

0 -

0 -

0 -

Roof Structure

m2

Simple roof (15°-25°) with low-cost iron sheets 221

3,256,881

Simple roof (15°-25°) with low-cost iron sheets 234

3,444,248

Simple roof (15°-25°) with low-cost iron sheets 247

3,639,881

78,798

Ground Floor

Rent

FRW Incl Land

47,676,928

Door Inside

pcs

Small door (steel frame/wood simple 0.8/2.0m) -

Small door (steel frame/wood simple 0.8/2.0m) -

Small door (steel frame/wood simple 0.8/2.0m) -

0 -

0 -

0 -

Concrete Footings

0 -

FRW excl. Land

371.21

Costs FRW

Offers’ Average

Partitions

m2

Modern Bricks facing 10cm -

Modern Bricks facing 10cm -

Modern Bricks facing 10cm -

Modern Bricks facing 10cm 0 -

FRW excl. Land

1,279,294

Sanitary equipment dwelling

Shared system (water tank and septic tank) 4

1,513,333

Shared system (water tank and septic tank) 5

1,891,667

Shared system (water tank and septic tank) 6

2,270,000

Total Plot Size (m2) / Total Plot Price (FRW)

28

4,227,118

Window

Kitchen

Bathroom

pcs

Bathroom (steel frame/wood simple 0.6-1.0m3) 4

398,173

Bathroom (steel frame/wood simple 0.6-1.0m3) 10

995,432

Bathroom (steel frame/wood simple 0.6-1.0m3) 6

597,259

42,429,839

618

Select your building material from drop down menu

3.5

FRW Incl Land

1,645,545

In addition to the Excel-based tools, the WebPortal features access to information about affordable housing construction value chains, training manuals for designers, planners and builders, along with a link to Buildapedia, the PROECCO project’s online database of building material producers and construction techniques.
**ANNEX 4 BASE MAPS FOR DEVELOPING MODERN BRICK SUPPLY FOR URBAN AGGLOMERATIONS**

**BRICK SECTOR DATA OVERLAIRED WITH MASTER PLAN LAND USE SPECIFICATIONS**

Since 2012, the PROECO project has consistently collected data and mapped location information for producers of brick and tiles across Rwanda. This information is overlaid on land use plan to facilitate the urbanization agenda. It follows that in 2016, the project introduced the Scenario Maker Tool, a tool that estimates the future demand of building materials in City of Kigali and the 6 Secondary Cities.

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**Scenario-Maker for Walling and Floor Material Supply for CoK and Secondary Cities**

<table>
<thead>
<tr>
<th>District</th>
<th>Brickyards which can be upgraded and equipped with Manual Extruders</th>
<th>Modern Bricks from existing upgraded brickyards</th>
<th>Demand for Modern Bricks which could be covered by upgraded kilns</th>
<th>Remaining Informal Houses (Adobe etc)</th>
<th>Market share of traditional brick houses</th>
<th>Market share of Modern Brick Houses (english Bond)</th>
<th>Market share of Modern Brick Duplexes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huye District</td>
<td>7</td>
<td>16</td>
<td>10</td>
<td>-</td>
<td>3%</td>
<td>8%</td>
<td>0%</td>
</tr>
<tr>
<td>Musanze District</td>
<td>79</td>
<td>16</td>
<td>10</td>
<td>-</td>
<td>3%</td>
<td>8%</td>
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</tr>
<tr>
<td>Rubavu</td>
<td>129</td>
<td>12</td>
<td>129</td>
<td>-</td>
<td>3%</td>
<td>8%</td>
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</tr>
</tbody>
</table>

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**AnnEx 5 BAsE MAps FOR DEvElOpIng MODERn BRIcK supplY FOR uRBAn AgglOMERAtIons**

**THE ZIG ZAG KILN TECHNOLOGY IS A KEY FEATURE FOR ENVIRONMENTALLY FRIENDLY BRICK PRODUCTION**

Top: Semi-industrial factory in Rugende, on the outskirts of Kigali. Projected annual capacity between 2.5 and 3.5 million bricks per annum. First firing scheduled for September 2017.

Middle: 3D Visualizations of ZigZag Kilns in the planning (2 in Bugesera Districts and 1 in Huye) and construction (Bujumbura and Ngozi, Burundi) phases.

Bottom: Plan of ZigZag kiln factory based on an optimized workflow.