



MODERN BRICK CONSTRUCTION SYSTEMS

A CATALOG OF AFFORDABLE HOUSING SOLUTIONS



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development
and Cooperation SDC

skat Swiss Resource Centre and
Consultancies for Development

PROECCO PROMoting Employment through
Climate Responsive CONstruction

FOREWORD

HOUSING CONSTRUCTION: AN ENGINE FOR EMPLOYMENT AND ECONOMIC GROWTH

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

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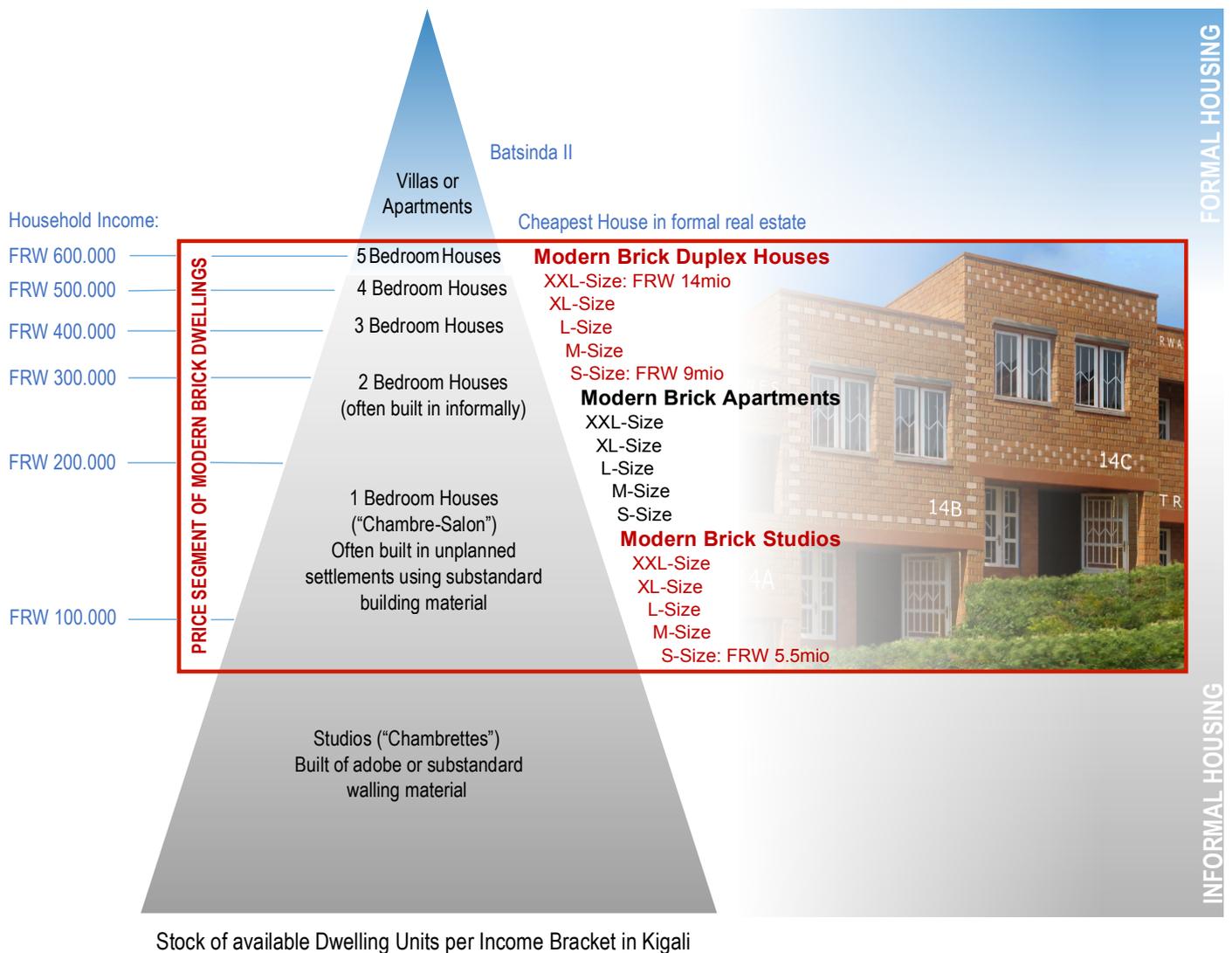
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MODERN BRICK MULTIPLEXES CAN BE AFFORDABLE TO MEDIUM-INCOME EARNERS

LOCAL BUILDING MATERIALS CAN GENERATE VIABLE SOLUTIONS TO HOUSING SUPPLY CHALLENGES

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,

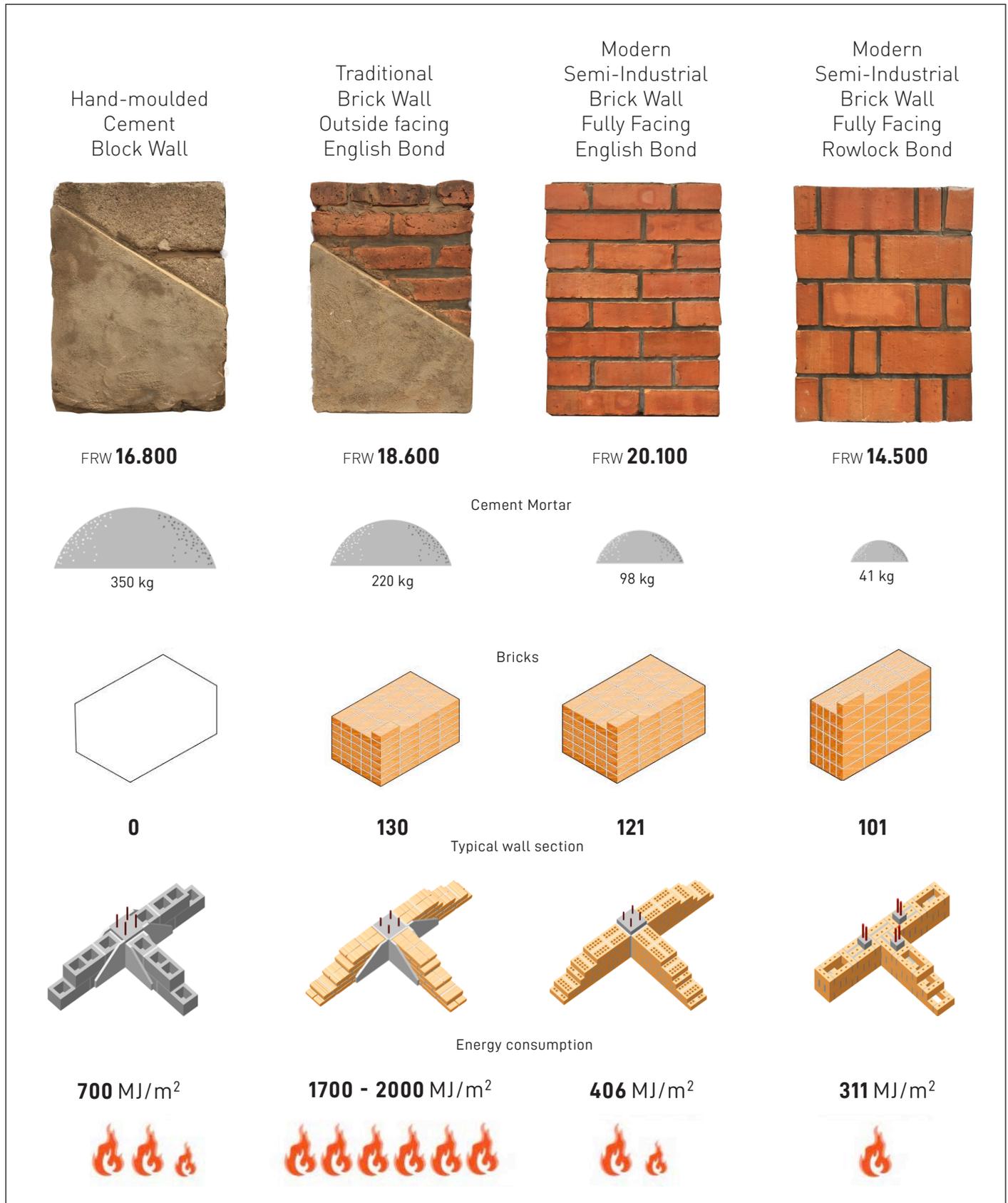
with the support of the Swiss Agency for Development and Cooperation, have started to produce machine-made Modern Bricks that allow for the construction of smart and cost-effective buildings. These technologies have the potential to significantly reduce the cost of housing and construction and bring 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'

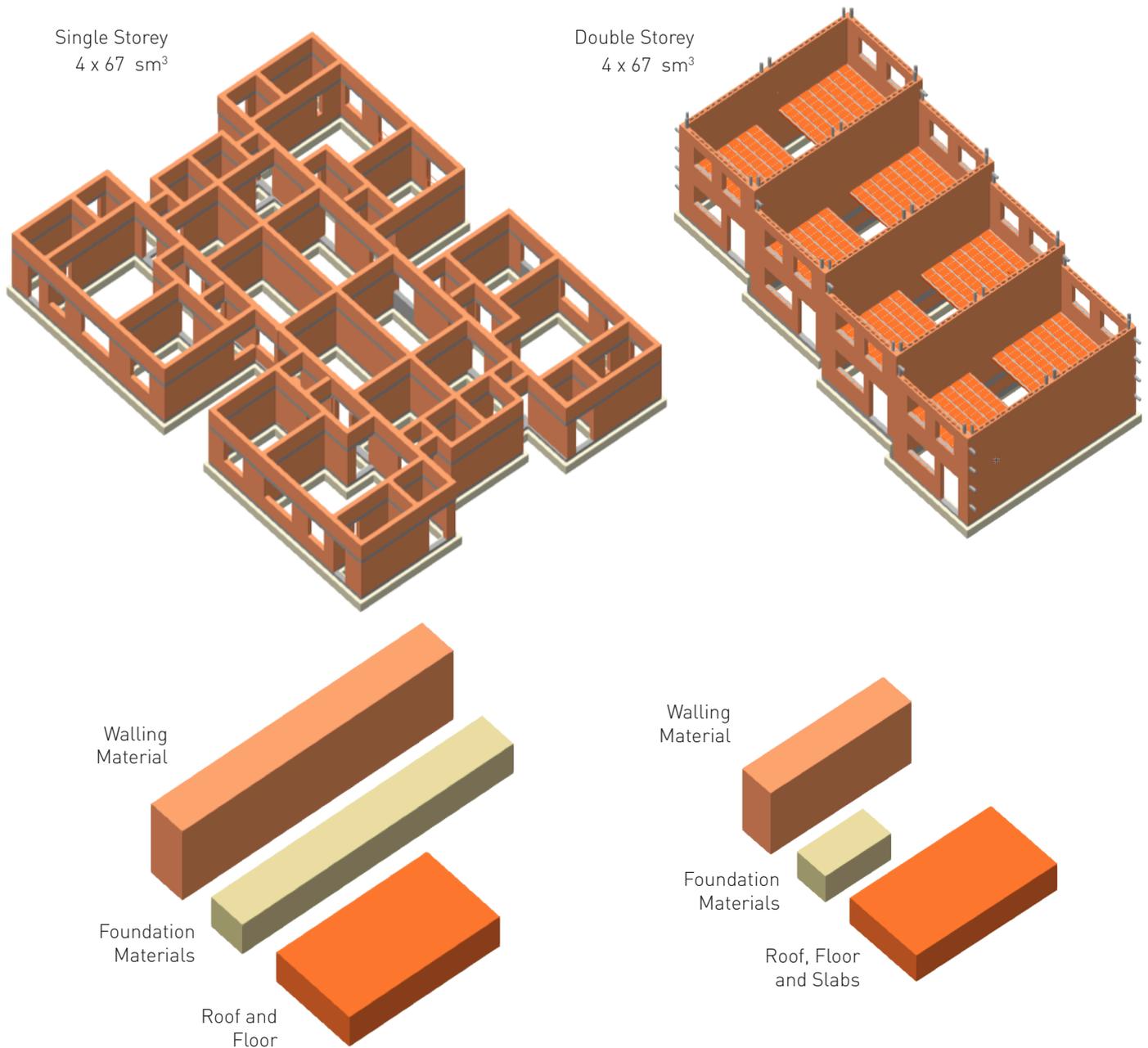
BREAKDOWN OF MATERIAL COSTS
PER SQUARE METER OF WALL (INCLUDING TAXES)



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

STRUCTURAL DESIGN DRIVES COST SAVINGS

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.



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.

- The S-size shell of a Modern Brick House Duplex (58m²), ready for interior works, costs FRW 9 mio
- A Modern Brick Duplex with 3 bedrooms costs less than FRW 12 mio (5 bedrooms: FRW 17 mio)
- Modern Brick Apartments can be built for less FRW 10 mio, Studios for less than FRW 5 mio
- A common plot can accommodate up to 12 duplexes, 14 simplexes or even 28 equipped studios!

REASON N° 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



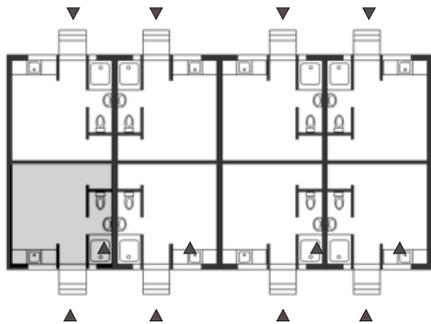
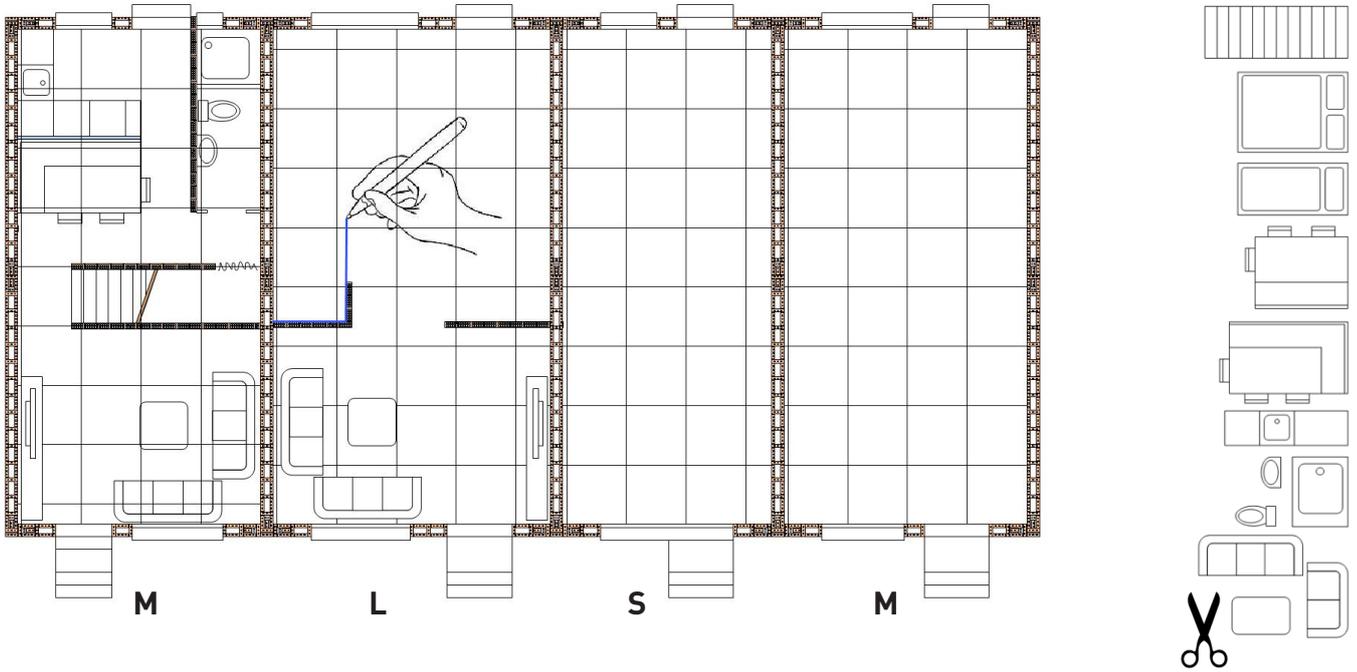
Overview of modern brick duplex sizes and related costs* and options on how they can be used.

	SHELL	DUPLEX	APARTMENT	STUDIO	BACK-TO- BACK
XXL 5.25m x 8.3m 86m ² or 2 x 43m ²					
	12.6 mio	17.2 mio	10.5 mio	5.2 mio	
XL 4.9m x 8.3m 81m ² or 2 x 41m ²					
	12 mio	16.3 mio	9.7 mio	4.9 mio	
L 4.6m x 8.3m 77m ² or 2 x 38m ²					
	11.8 mio	15.6 mio	8.5 mio	4.7 mio	
M 4.1m x 8.3m 67m ² or 2 x 33m ²					
	10 mio	12.8 mio	7.4 mio	4.4 mio	
S 3.78m x 8.3m 63m ² or 2 x 29m ²					
	9.2 mio	12.3 mio	8.6 mio	4.1 mio	
XS 3.5m x 8.3m 58m ² or 2 x 29m ²					
	7.5 mio	11.2 mio	6.2 mio	3.7 mio	

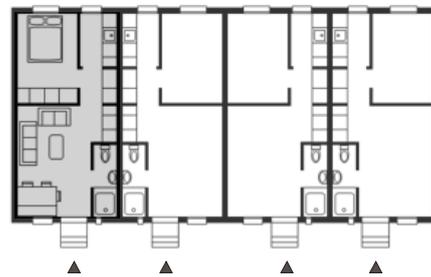
*Calculated based on a simple plot in Kigali context that include all installations as well as tax and profit. Land excluded.

REASON N° 4: THE INTERIOR OF A MODERN BRICK MULTIPLEX CAN BE CUSTOMISED AND CHANGED OVER TIME

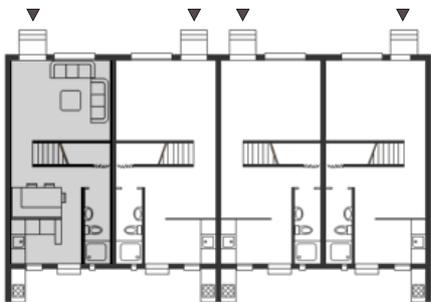
ROOMS + WALLS CAN BE BUILT INCREMENTALLY IN RESPONSE TO EVOLVING NEEDS



2016
 Neighborhood Services: Water & Electricity only
 Tenant Profile: Shop Employees, Taximoto 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)



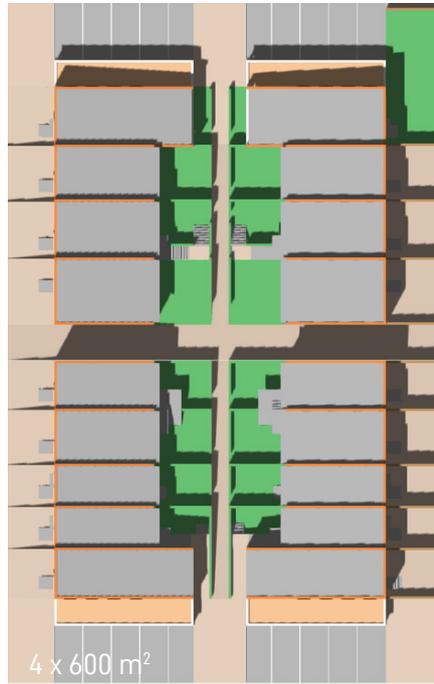
2028
 Neighborhood Services: Asphalt Road
 Tenant Profile: Clerks, Junior Engineers, Shopkeepers
 Tenant income per HH: 400.000
4 duplexes @ 130.000/month



2036
 Neighborhood Services: Public Transportation
 Tenant Profile: Civil Servants, Entrepreneur
 Tenant income per HH: 600.000
2 rowhouses @ 200.000/month

REASON N° 5: MODERN URBAN BRICK MULTIPLEXES ARE SINGLE-PLOT SOLUTIONS FOR SMALL-SCALE LANDLORDS

ADAPTABLE TO ANY PLOT GEOMETRY, TOPOGRAPHY AND TENANT PROFILE

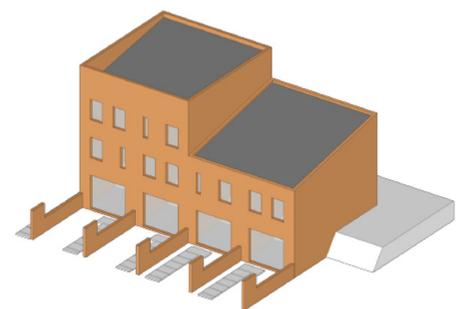


Adaptability

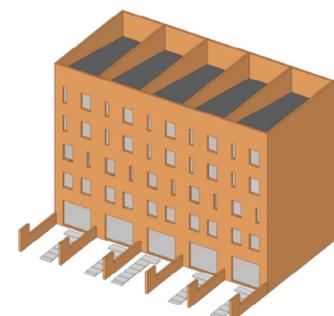
A standard plot size of 600 m² (20m x 30m) can accommodate a variety of duplex combinations (from rowhouses to apartment blocks), depending on the purchasing power of owners and tenants.

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

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.



Low-rise high density 8-in-1 block



G+4 Housing Tower with 10 stacked units

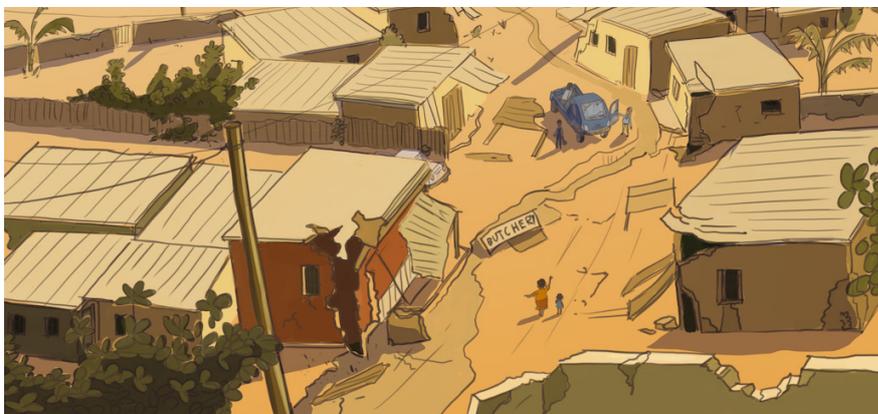
REASON N° 6: MODERN BRICK MULTIPLEXES ARE SUITABLE FOR SMALL NEIGHBORHOOD-LEVEL MICRO ESTATES

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.

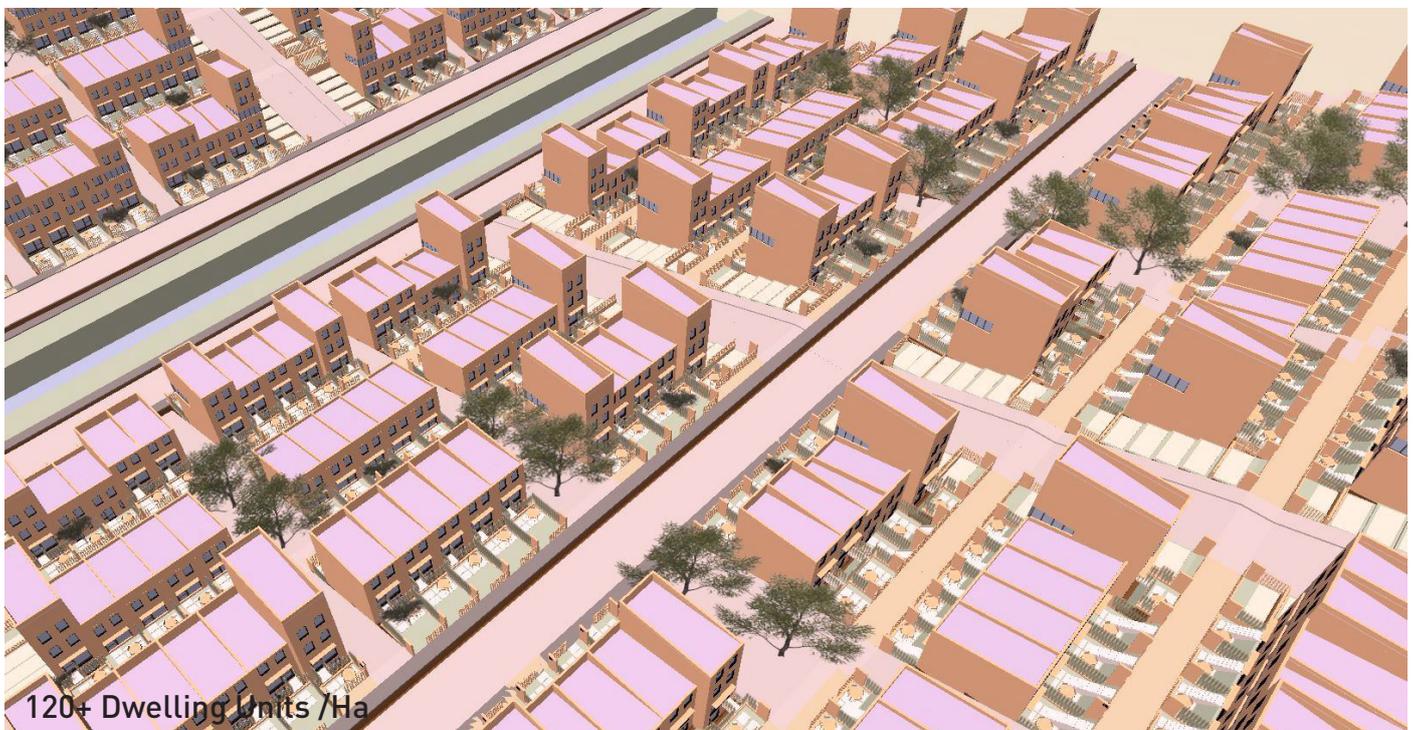
Ideally, two or three neighbours would come together to create a small city block with the architectural and environmental qualities of a small estate with sufficient parking, walkways, private courtyards and a recognizable address.



Top: Illustrated neighborhood community upgrading process supported by City officials
Bottom: Transformation of an existing unplanned settlement in Kigali's Nyarugenge District, Kimisagara Sector (2018 - 2020)

REASON N° 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



High-densities are achievable even on challenging and sloped terrains



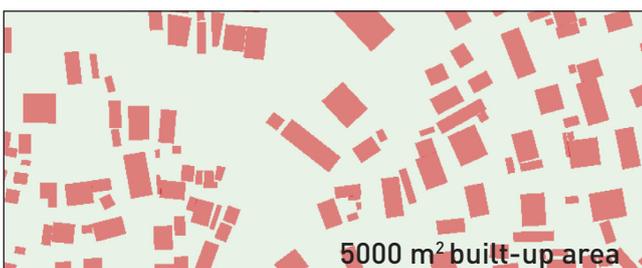
REASON N° 8: SMART DENSIFICATION ALLOWS SMALL LANDOWNERS TO SELF-FINANCE NEIGHBORHOOD UPGRADING

LAND VALUE IN INFORMAL AREAS CAN BE UNLOCKED THROUGH COMPACT AFFORDABLE BUILDING SOLUTIONS



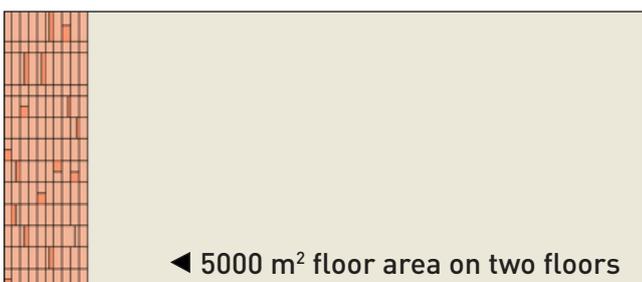
Irregular plot and building distribution

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

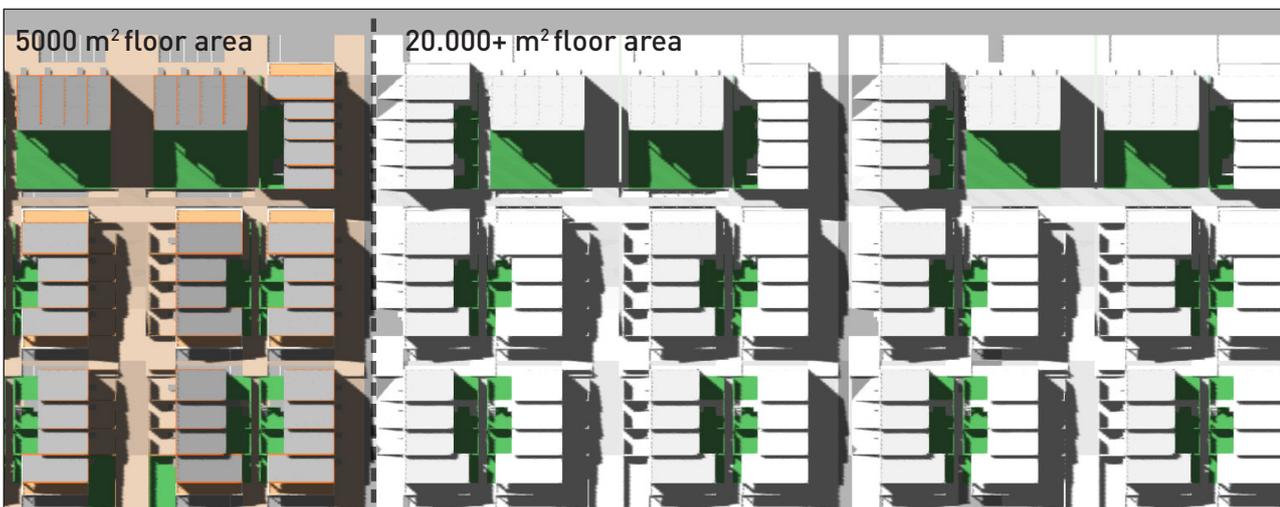
Building an additional floor and compacting structures can free up land for development.



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).

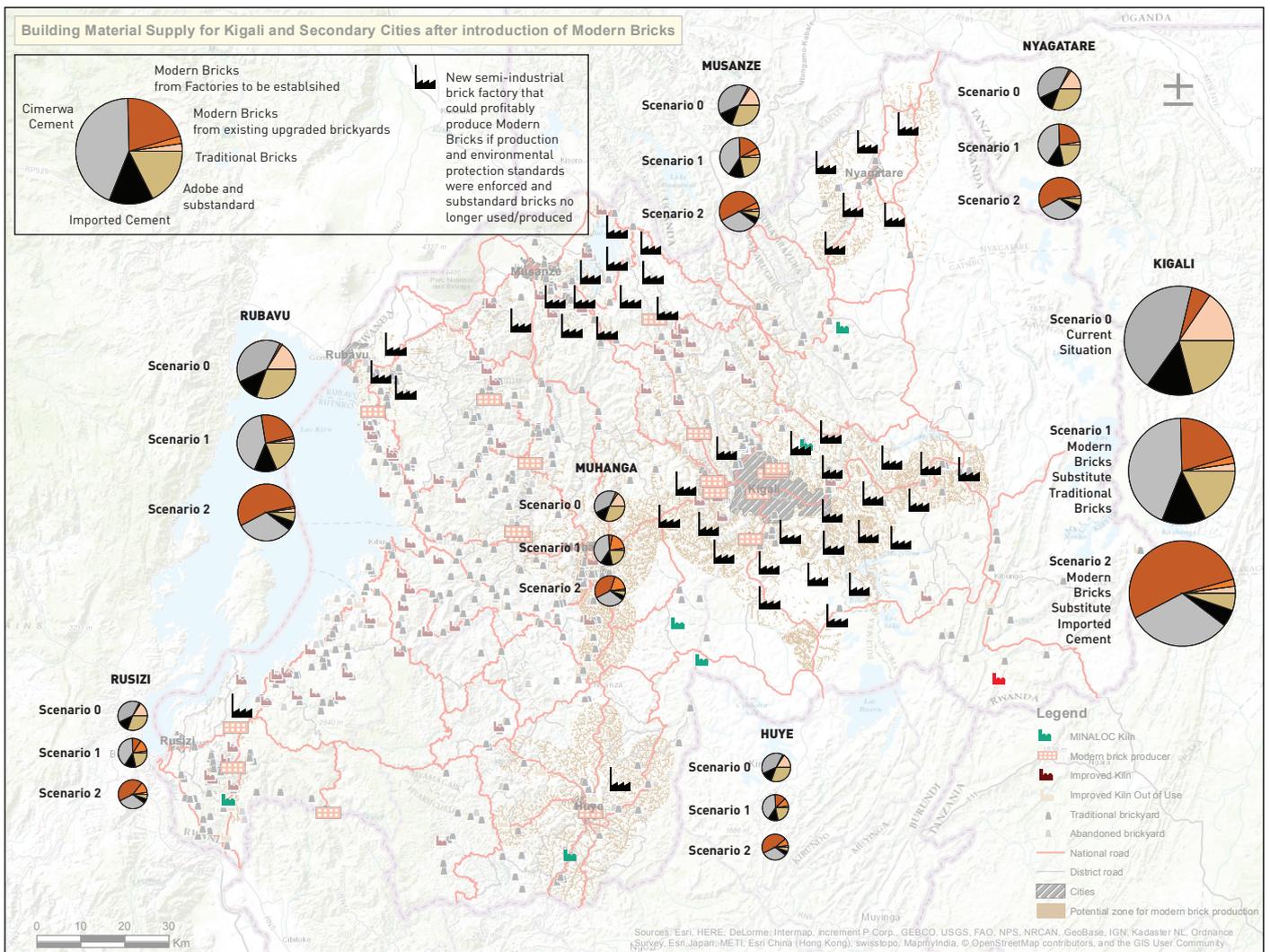
After self-financing, the floor area could be increased as per below.



REASON N° 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

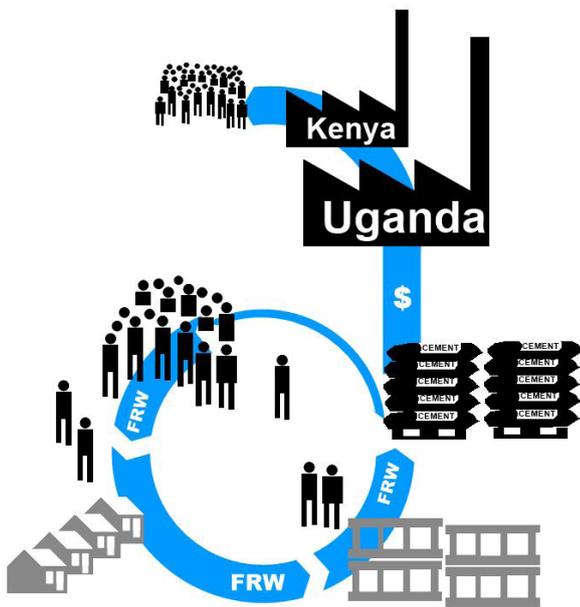
Even though the current production of Modern Bricks is still low, they can be - and, are - produced by existing small and medium-scale upgraded brickyards. 100 more could be upgraded and produce bricks for 3,000 houses per year. Given the annual demand of 40,000 - 50,000 new urban houses, **50** new 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	XL Semi-Industrial	L Artisanal	M Artisanal	S Upgraded Tile Kiln
Annual Output	3.000.000 Bricks (200-350 houses)	1.000.000 Bricks (70-110 houses)	600.000 Bricks (40-70 houses)	300.000 Bricks (20-35 houses)
New brickyards required for substituting:				
A: Traditional Bricks	50 brickyards - or -	150 brickyards - or -	190 brickyards - or -	380 brickyards
B: Cement Blocks	161 brickyards - or -	484 brickyards - or -	661 brickyards - or -	1,221 brickyards

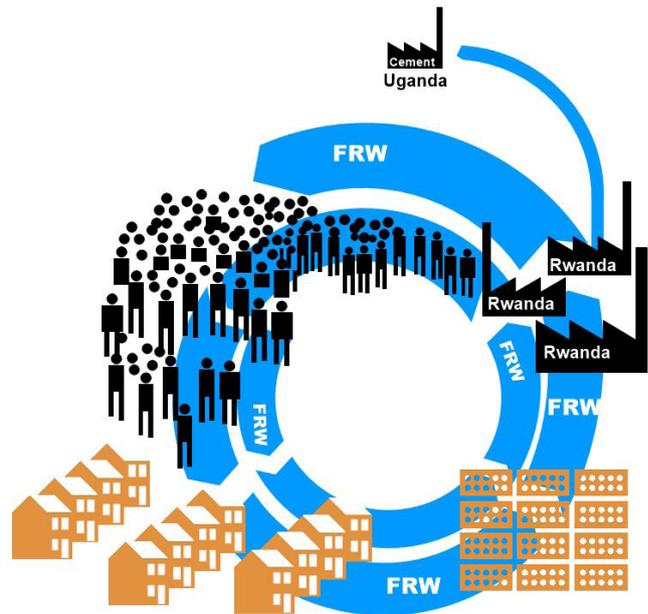
REASON N° 10: LOCAL BRICKS GENERATE LOCAL JOBS AND INCREASE THE MEDIUM INCOME

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.



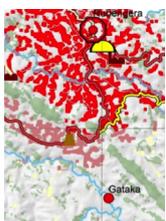
Modern Bricks Replace Concrete Blocks

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.

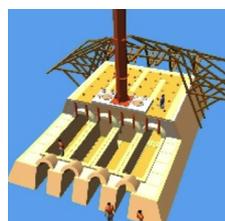
The transformation of Rwanda's brick industry will require targeted interventions and investments all along the value chain. The Swiss Agency for Development Cooperation has therefore mandated Skat Consulting to offer the following services to entrepreneurs, investors and technicians in the following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



Site and Clay Analysis



Business Design Support



Access to Technologies + Skills



Marketing Support

TAXONOMY

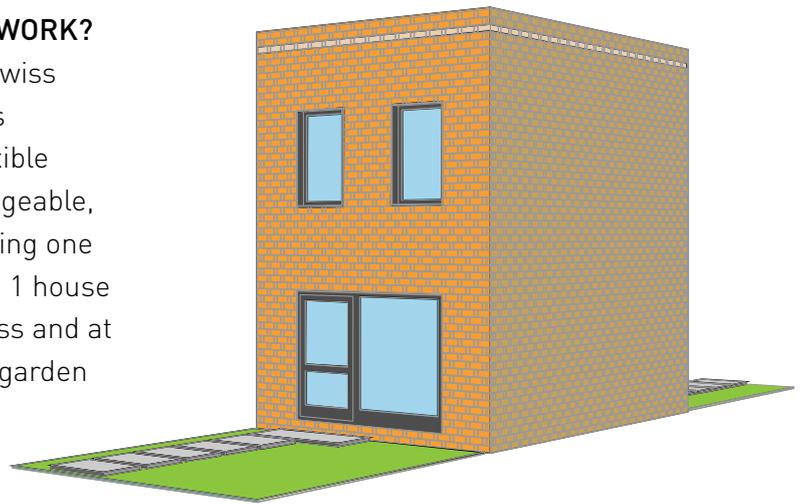
THE SWISS CUBE SYSTEM

THE SWISS CUBE SYSTEM IS SUITABLE TO MOST PLOT AND TERRAIN CONFIGURATIONS



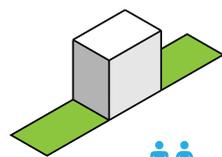
HOW DOES IT WORK?

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

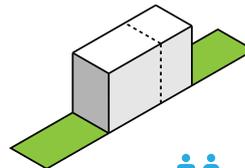


STRETCH

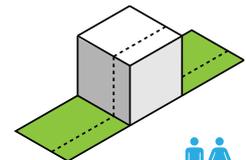
Extend or expand the cube to accommodate bigger families/budgets



S duplex



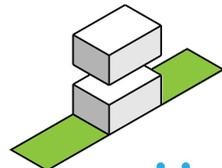
S Corner House



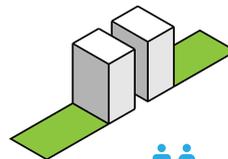
XXL duplex

SPLIT

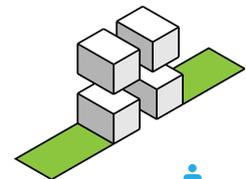
Maximize plot area by subdividing cube into smaller units



S superposed simplex



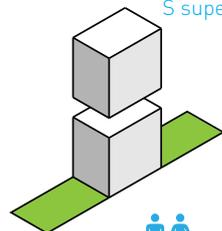
S back-to-back duplex



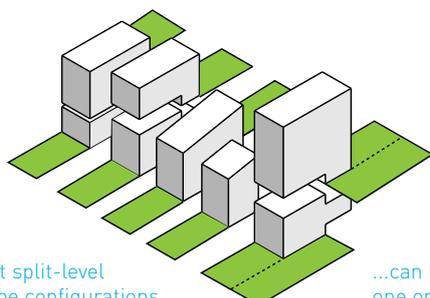
S studio

STACK

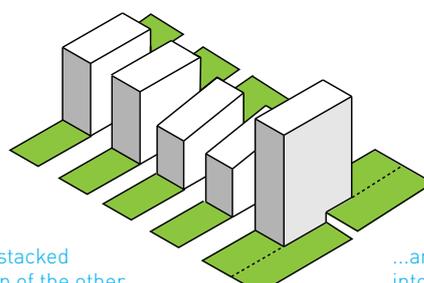
Superimpose the cube to maximize plot development without sacrificing precious liveable area



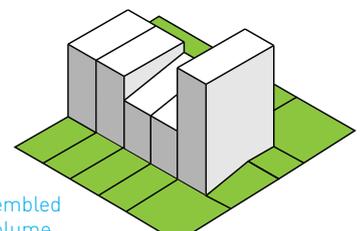
Stacked S duplexes



9 different split-level Swiss Cube configurations...



...can be stacked one on top of the other...



...and assembled into one volume...

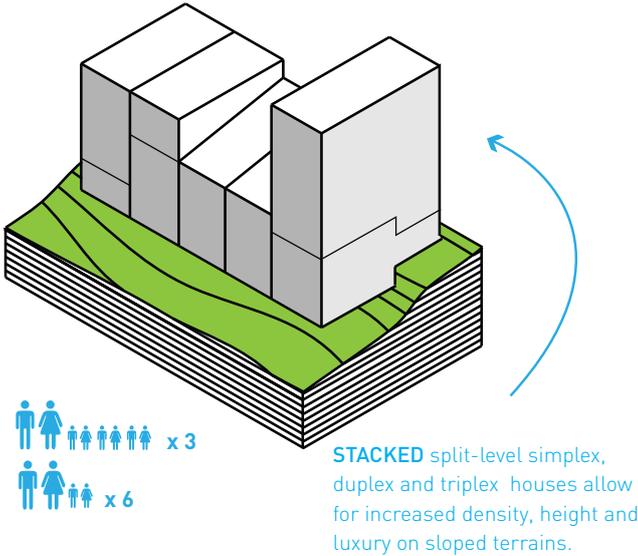
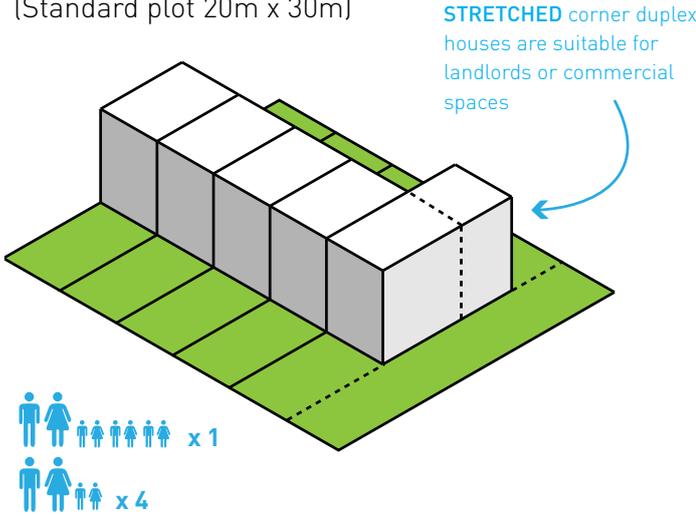
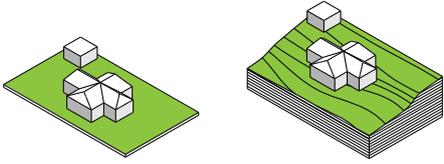
THE SWISS CUBE SYSTEM

THE SWISS CUBE SYSTEM IS SUITABLE TO MOST PLOT AND TERRAIN CONFIGURATIONS

MULTIPLY

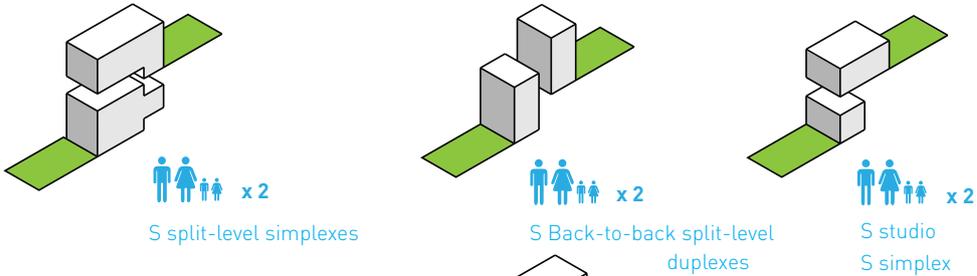
Maximize plot development and reduce construction costs by sharing external walls and infrastructure services (Standard plot 20m x 30m)

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



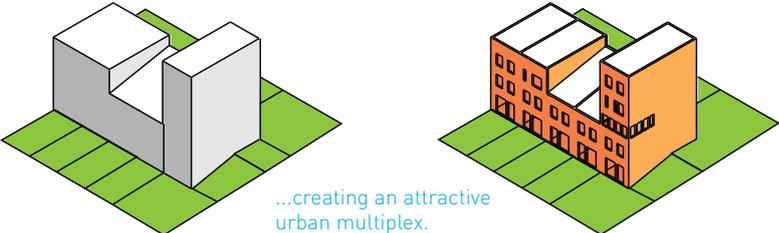
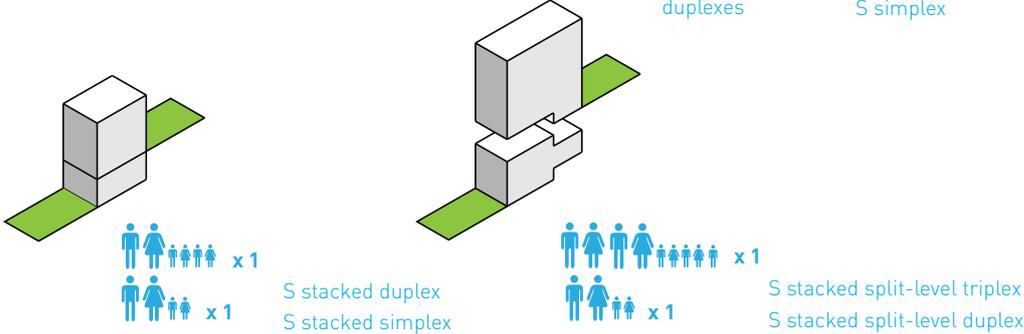
SPLIT ON A SLOPE

Maintain private garden access by introducing split-level units



STACK ON A SLOPE

Increase density by superposing one unit on another



...creating an attractive urban multiplex.

ANATOMY OF A BUILDING

Multiple units can be assembled on a standard plot without sacrificing basic amenities like direct road access and private gardens

XXL

starting from
FRW **12.650.000**



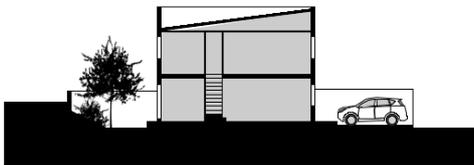
starting from
FRW **17.200.000**

XXL SHELL 86m²

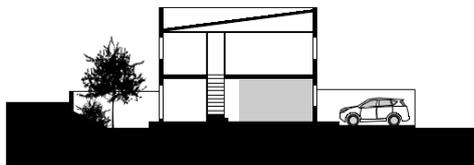
Interior Dimensions: 5.20m x 8.34m
 Room Height: 2.40m
 Walling Material: Fully Facing Modern Bricks
 Slab: Maxspan
 Flooring: Cement Screed
 Roofing Material: Iron Sheet

XXL DUPLEX 86m²

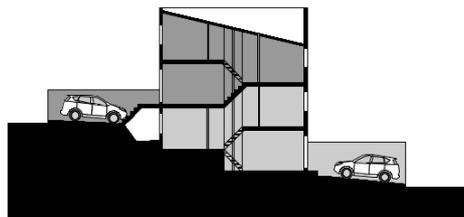
Living Room/Dining Room 20
 Master Bedroom 10
 Additional Bedrooms (x4) 32
 Kitchen ✓
 Bathroom ✓
 Storage ✓
 Garden ✓



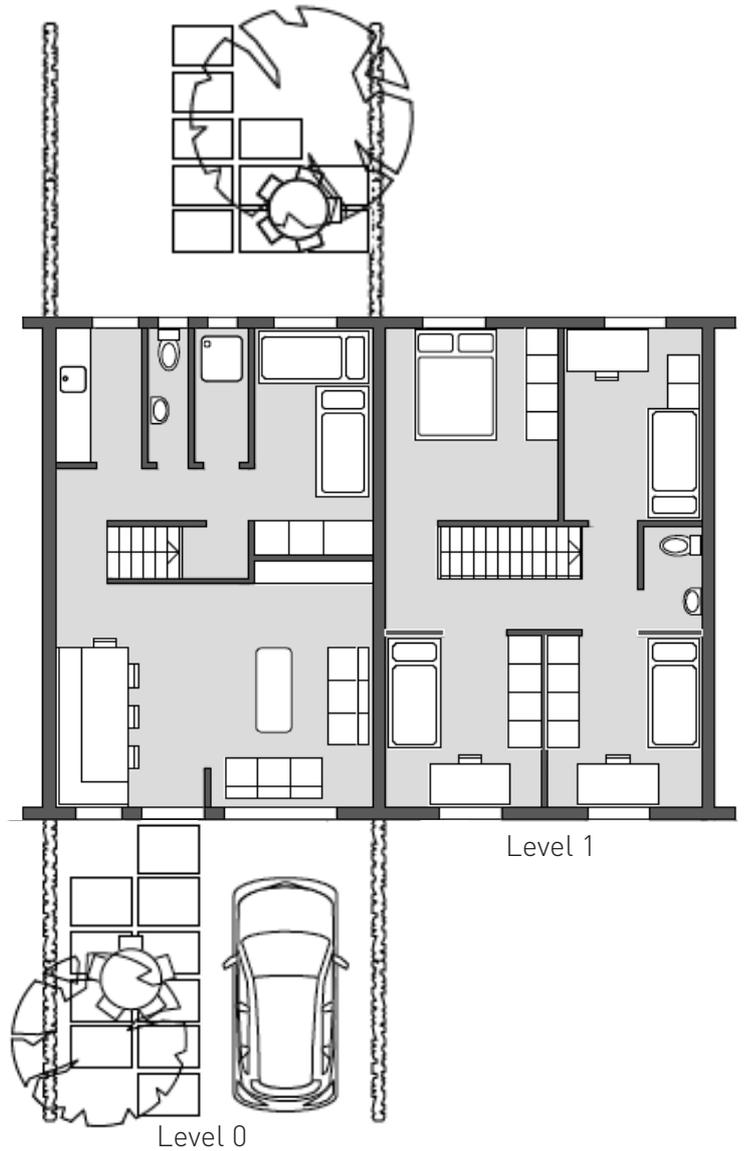
XXL Simple Duplex



XXL Apartment



XXL Double Split-level duplex



Level 1

Level 0





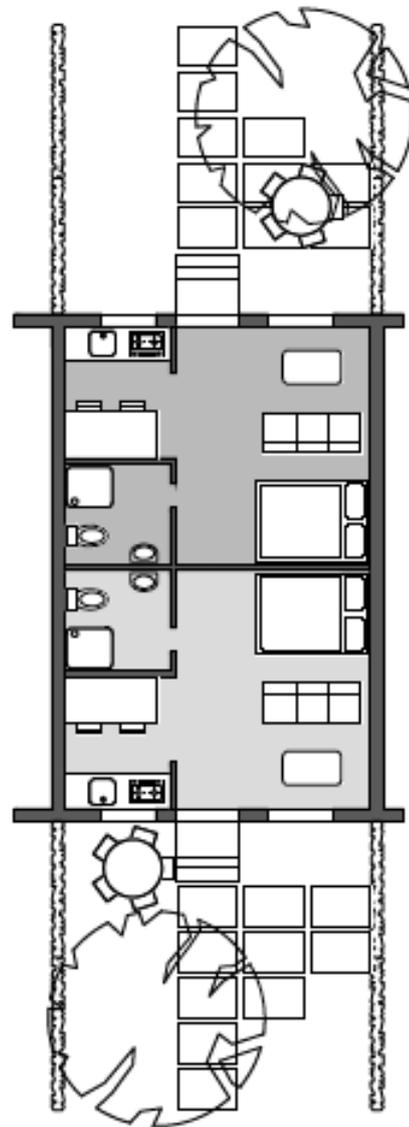
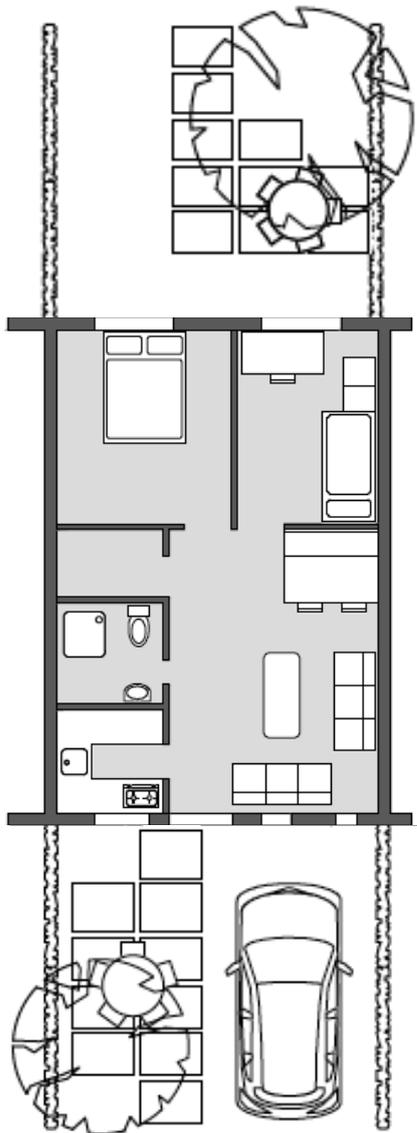
starting from
FRW **10.500.000**



starting from
FRW **5.200.000**

XXL SIMPLEX (1 unit per floor)	43m ²
Living Room/Dining Room	17
Master Bedroom	10
Additional Bedrooms (x1)	8
Kitchen	✓
Bathroom	✓
Storage	✓
Garden	✓

XXL STUDIO (2 units per floor)	21m ²
Living Room/Dining	13
Kitchen	✓
Bathroom	✓
Garden	✓



XXL



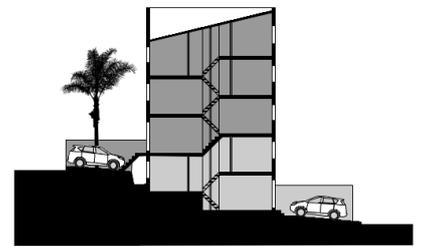
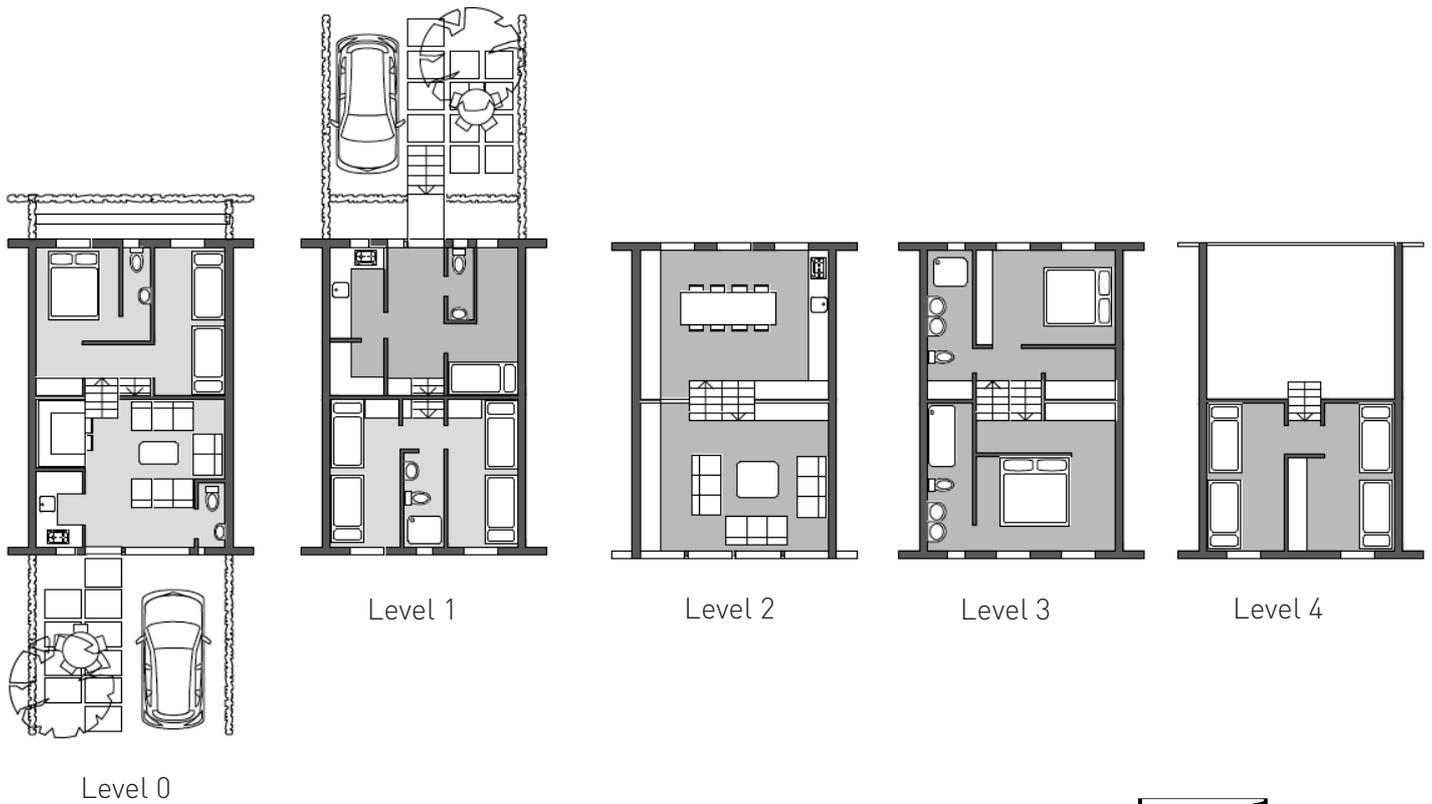
starting from
FRW **14.700.000**



starting from
FRW **30.500.000**

XXL 8-in-1 DUPLEX	64m ²
Living Room / Dining Room	16
Master Bedroom	8
Additional Bedrooms (x3)	24
Kitchen	✓
Bathroom (x3)	✓
Storage	✓
Garden	✓

XXL 8-in-1 TRIPLEX	130m ²
Living Room/Dining Room	43
Master Bedroom	13
Additional Bedrooms (x4)	35
Kitchen / Storage	8
Bathroom (x3)	✓
Storage	✓
Garden	✓



XXL Split-level Duplex and Triplex





starting from
FRW **9.800.000** / unit



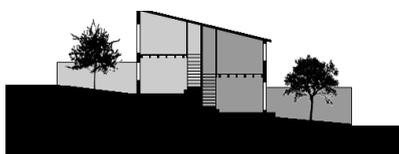
starting from
FRW **14.600.000** / unit

XXL BACK-TO-BACK DUPLEX (1 of 2 units)	43m ²
Living Room/Dining Room	17
Master Bedroom	8
Additional Bedrooms (x1)	8
Kitchen	✓
Bathroom	✓
Storage	✓
Garden	✓

XXL DOUBLE SPLIT LEVEL DUPLEX (1 of 2 units)	64m ²
Living Room/Dining Room	16
Master Bedroom	8
Additional Bedrooms (x3)	24
Kitchen	✓
Bathroom (x3)	✓
Storage	✓
Garden	✓

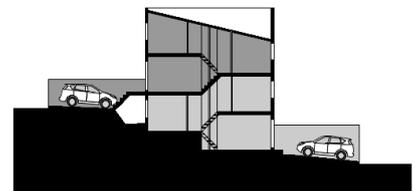


- Unit 1
- Unit 2

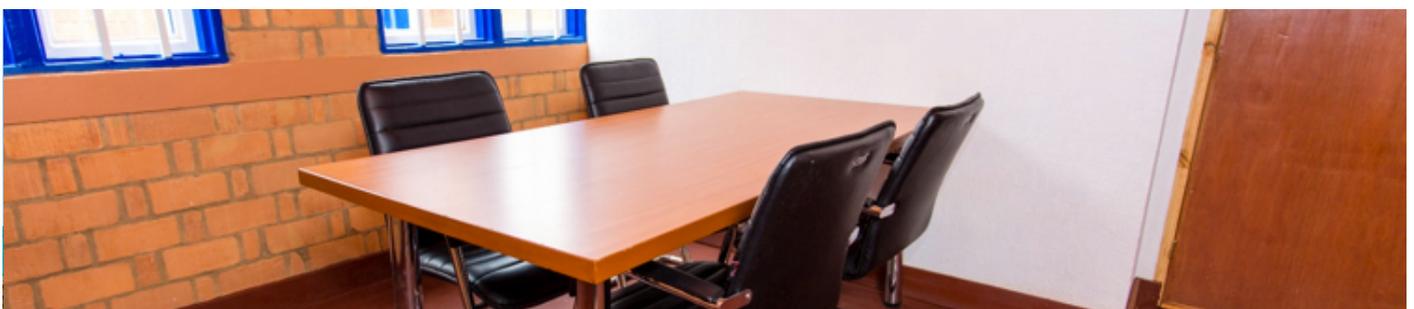


XXL Split-level Back-to-Back

- Unit 1 L0 - L1
- Unit 2 L1 - L2



XXL Double Split-level Duplex



XL

starting from
FRW **12.000.000**



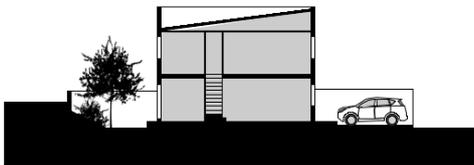
starting from
FRW **16.300.000**

XL SHELL 81m²

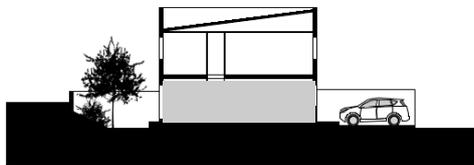
Interior Dimensions: 4.92m x 8.34m
Room Height: 2.40m
Walling Material: Fully Facing Modern Bricks
Slab: Maxspan
Flooring: Cement Screed
Roofing Material: Iron Sheet

XL DUPLEX 81m²

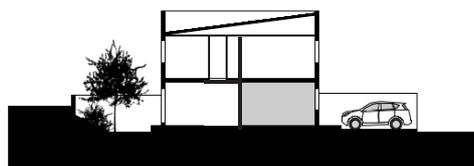
Living Room/Dining Room 21
Master Bedroom 10
Additional Bedrooms (x3) 24
Kitchen ✓
Bathroom ✓
Storage ✓
Garden ✓



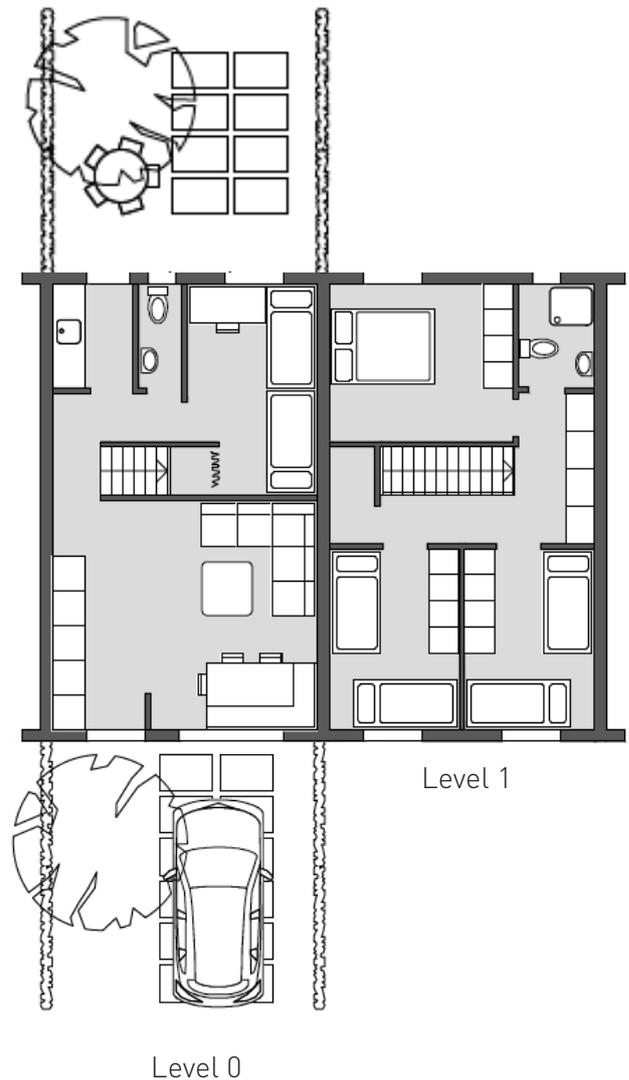
XL Duplex



XL Simplex



XL Studio



Level 1

Level 0





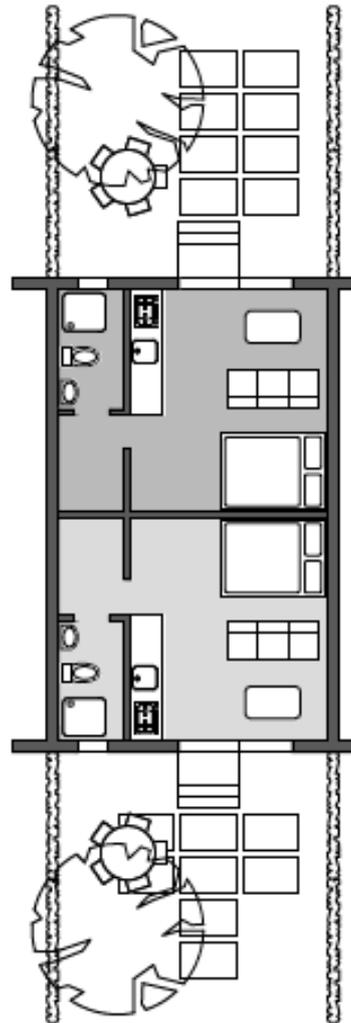
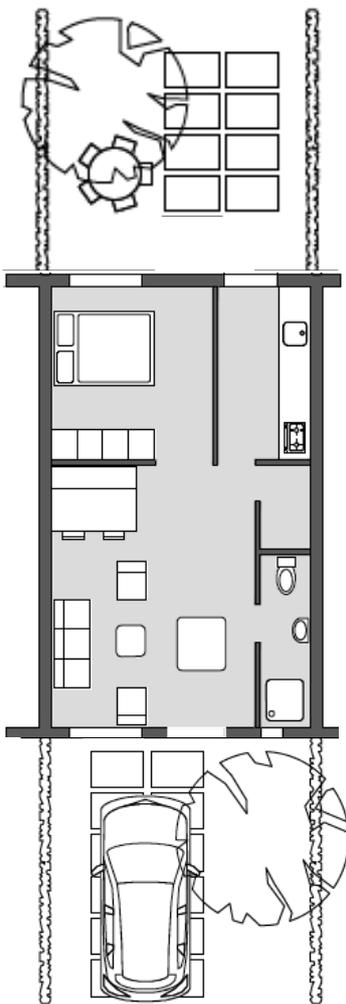
starting from
FRW **9.700.000**



starting from
FRW **4.900.000**

XL SIMPLEX	40m ²
Living Room/Dining Room	15
Master Bedroom	10
Kitchen	✓
Bathroom	✓
Storage	✓
Garden	✓

XL STUDIO (1 of 2 units)	20m ²
Living Room/Bedroom	14
Kitchen	✓
Bathroom	✓
Garden	✓





starting from
FRW **11.800.000**



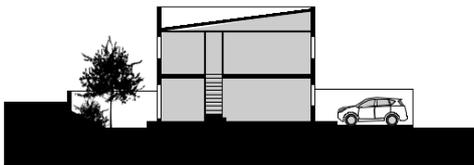
starting from
FRW **15.600.000**

L SHELL 77m²

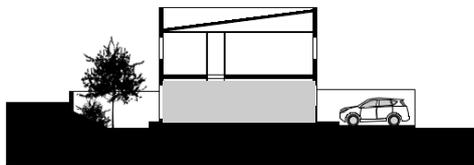
Interior Dimensions: 4.63m x 8.34m
Room Height: 2.40m
Walling Material: Fully Facing Modern Bricks
Slab: Maxspan
Flooring: Cement Screed
Roofing Material: Iron Sheet

L DUPLEX 77m²

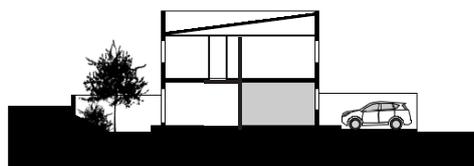
Living Room/Dining Room	20
Master Bedroom	10
Additional Bedrooms (x3)	24
Kitchen	✓
Bathroom	✓
Storage	✓
Garden	✓



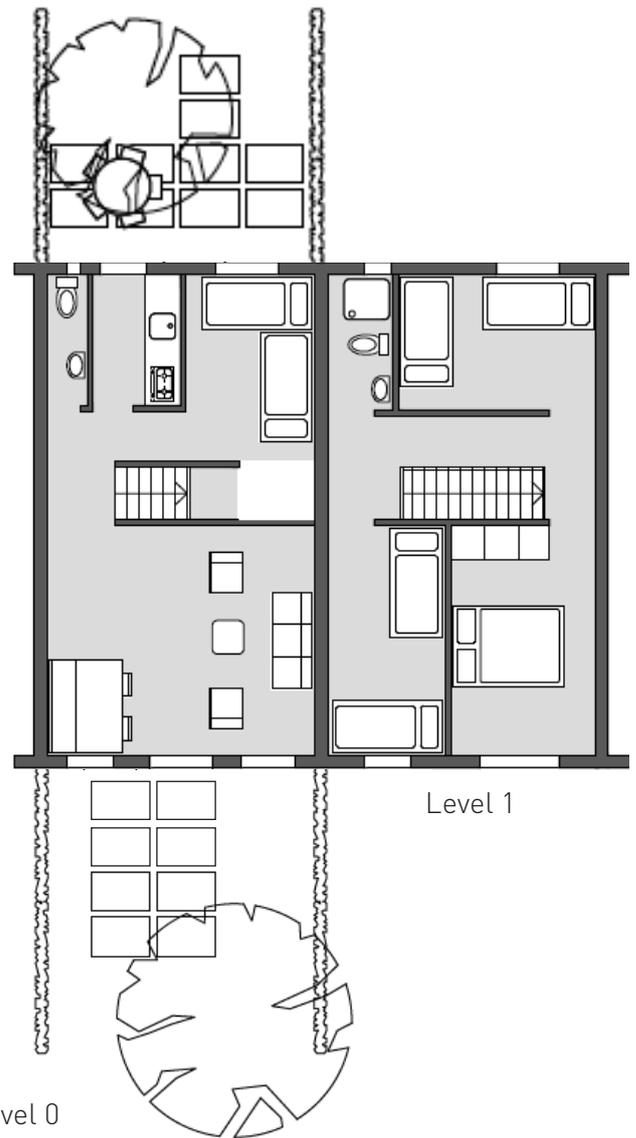
L Single Duplex



L Simplex



L Studio





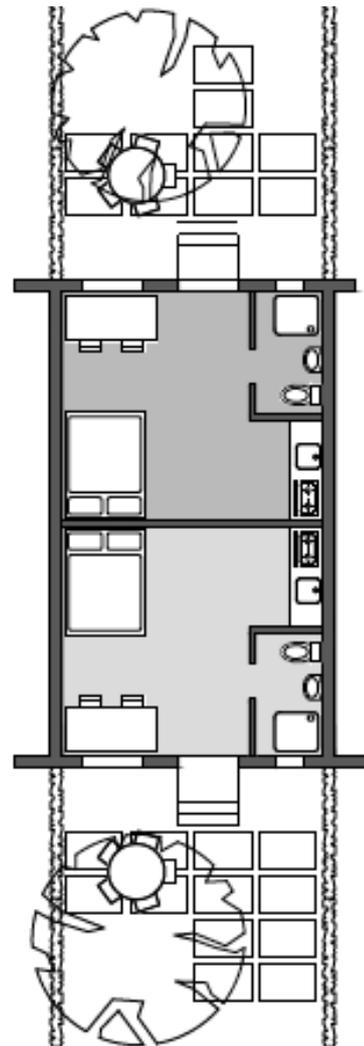
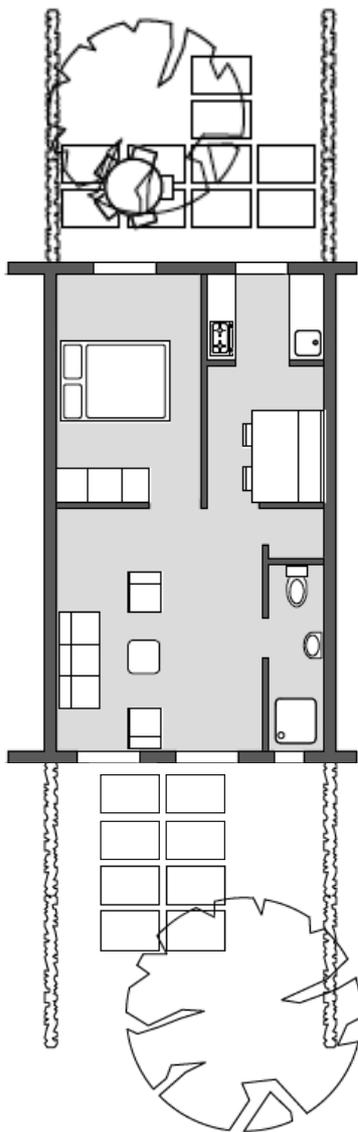
starting from
FRW **8.500.000**



starting from
FRW **4.750.000 / unit**

L SIMPLEX	38m ²
Living Room/Dining Room	15
Master Bedroom	10
Additional Bedrooms	8
Kitchen	✓
Bathroom	✓
Storage	✓
Garden	✓

L STUDIO (1 of 2 units)	19m ²
Living Room/Bedroom	14
Kitchen	✓
Bathroom	✓
Garden	✓



M

starting from
FRW **10.000.000**



starting from
FRW **12.800.000**

M SHELL 67m²

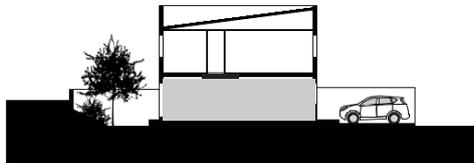
Interior Dimensions: 4.06m x 8.34m
 Room Height: 2.40m
 Walling Material: Fully Facing Modern Bricks
 Slab: Maxspan or Timber Floor
 Flooring: Cement Screed
 Roofing Material: Iron Sheet

M DUPLEX 67m²

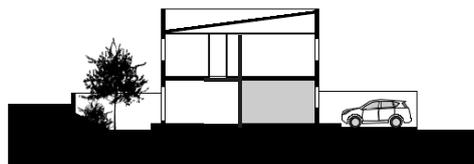
Living Room / Dining Room	27
Master Bedroom	9
Additional Bedrooms (x2)	16
Kitchen	✓
Bathroom x1 (or x2)	✓
Storage	✓
Garden	✓



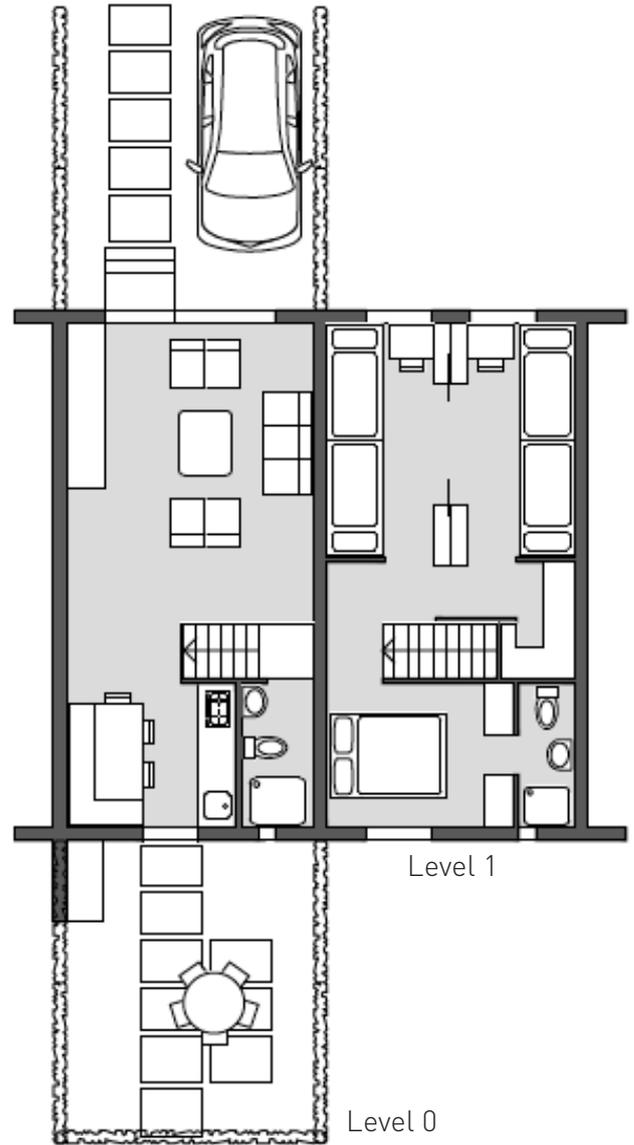
M Duplex



M Simplex



M Studio





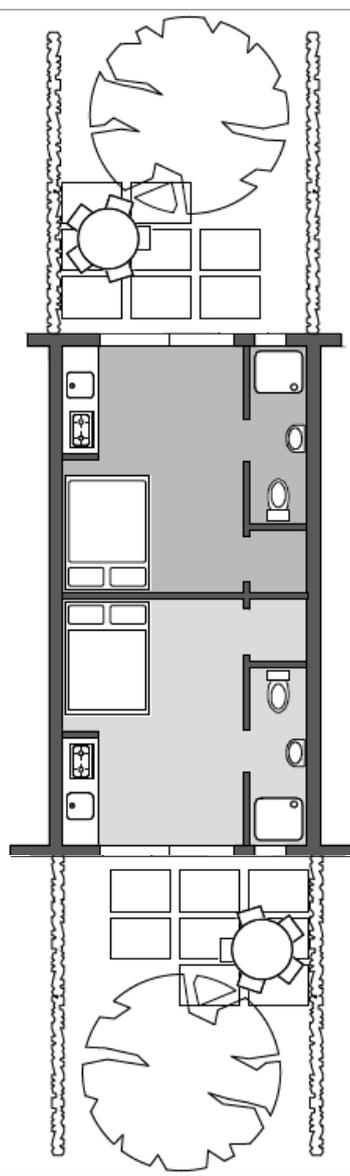
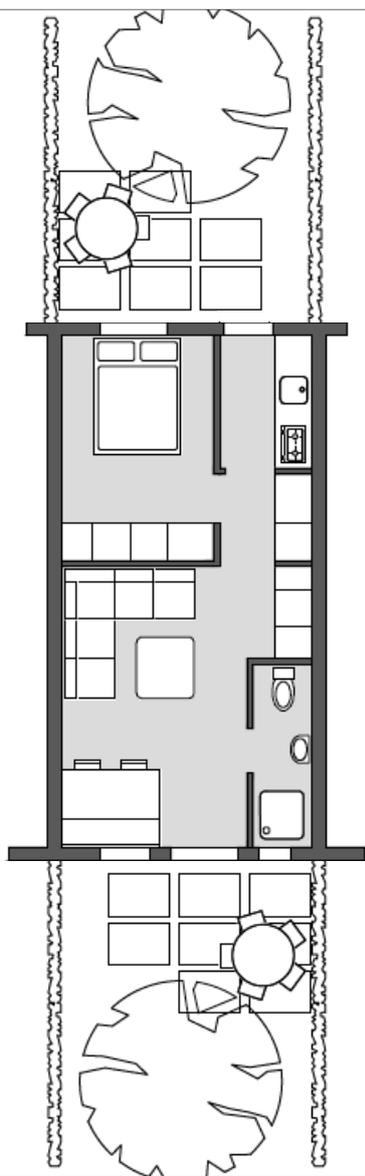
starting from
FRW **7.400.000**



starting from
FRW **4.400.000 / unit**

M SIMPLEX	33m ²
Living Room/Dining Room	15
Master Bedroom	9
Kitchen	✓
Bathroom	✓
Storage	✓
Garden	✓

M STUDIO (1 of 2 units)	16m ²
Living Room/Bedroom	11
Kitchen	✓
Bathroom	✓
Garden	✓



S

starting from
FRW **9.200.000**



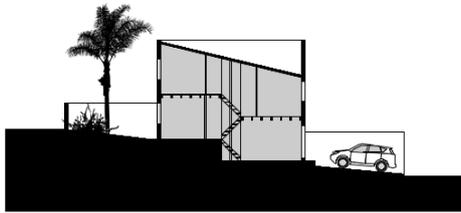
starting from
FRW **12.300.000**

S SHELL 63m²

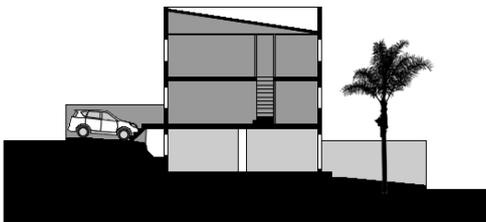
Interior Dimensions: 3.78m x 8.34m
 Room Height: 2.40m
 Walling Material: Fully Facing Modern Bricks
 Slab: Timber Floor / Maxpan between units
 Flooring: Cement Screed
 Roofing Material: Iron Sheet

S SINGLE SPLIT-LEVEL DUPLEX 63m²

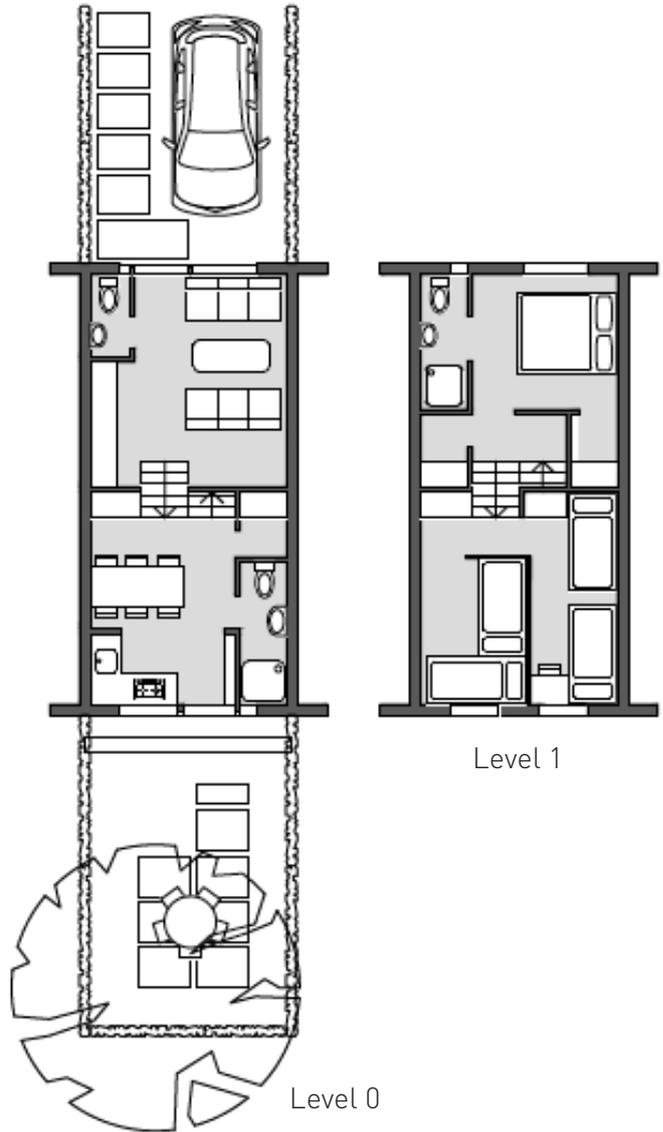
Living Room / Dining Room 20
 Master Bedroom 9 - 11
 Additional Bedrooms (x2) 16 (or 7+7)
 Kitchen ✓
 Bathroom (x2 or x3) ✓
 Storage ✓
 Garden ✓



S Single Split-level Duplex



S Simplex + S Duplex





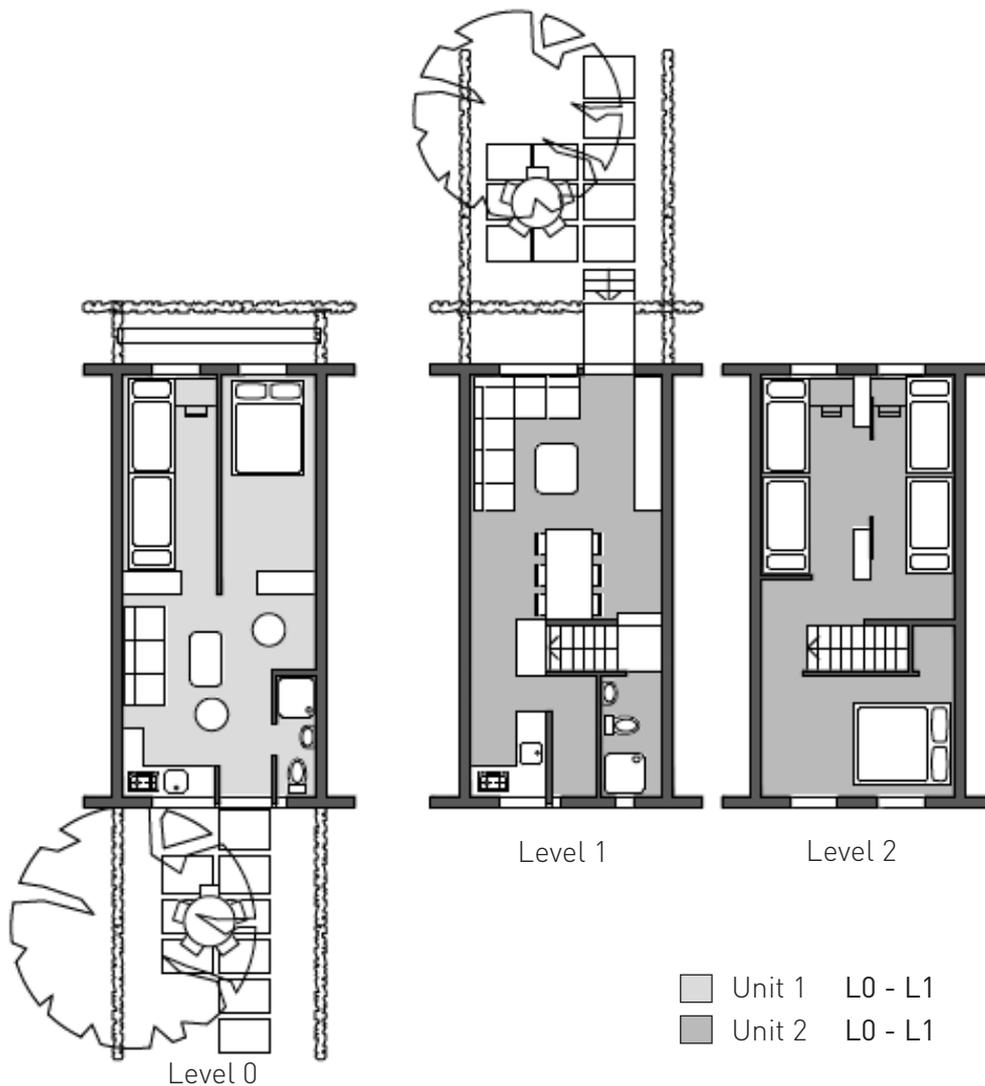
starting from
FRW **8.600.000**



starting from
FRW **11.500.000**

S SIMPLEX	31m ²
Living Room / Dining Room	13
Master Bedroom	8
Additional Bedroom (x1)	8
Kitchen	✓
Bathroom	✓
Storage	✓
Garden	✓

S DUPLEX	63m ²
Living Room / Dining Room	19
Master Bedroom	10
Additional Bedrooms (x2)	16
Kitchen	✓
Bathroom (x1)	✓
Garden	✓



S



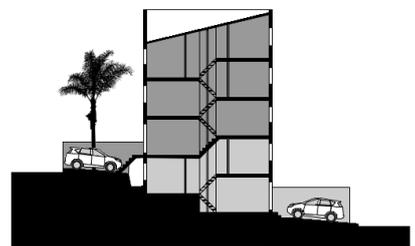
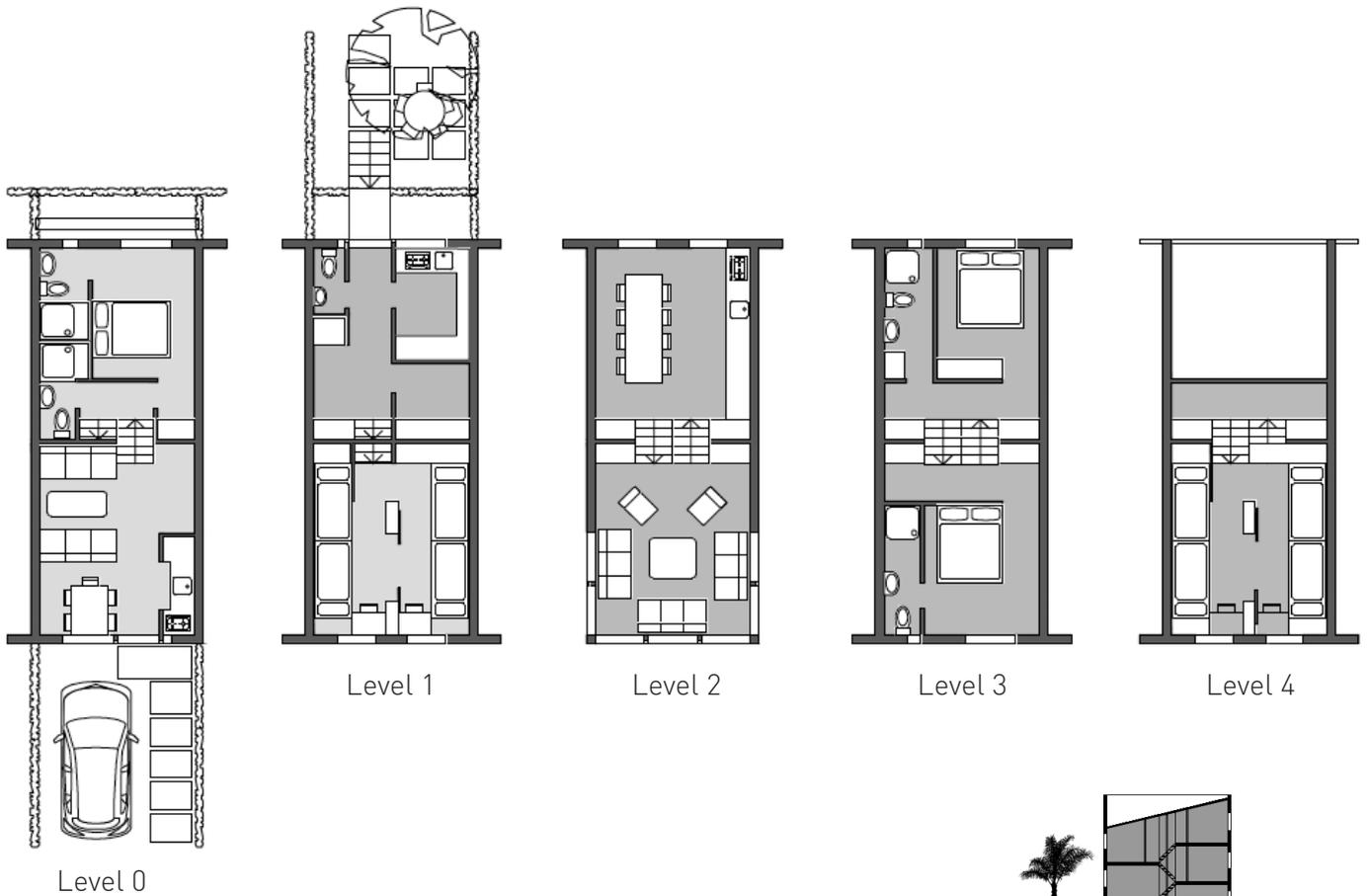
starting from
FRW **10.500.000**



starting from
FRW **22.000.000**

S SLOPE SPLIT LEVEL DUPLEX (Unit 1)	54m ²
Living Room/Dining Room	13.5
Master Bedroom	9
Additional Bedrooms (x2)	15 (or 6 +7)
Kitchen	✓
Bathroom (x2)	✓
Storage	✓
Garden	✓

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



S Split-level Duplex and Triplex





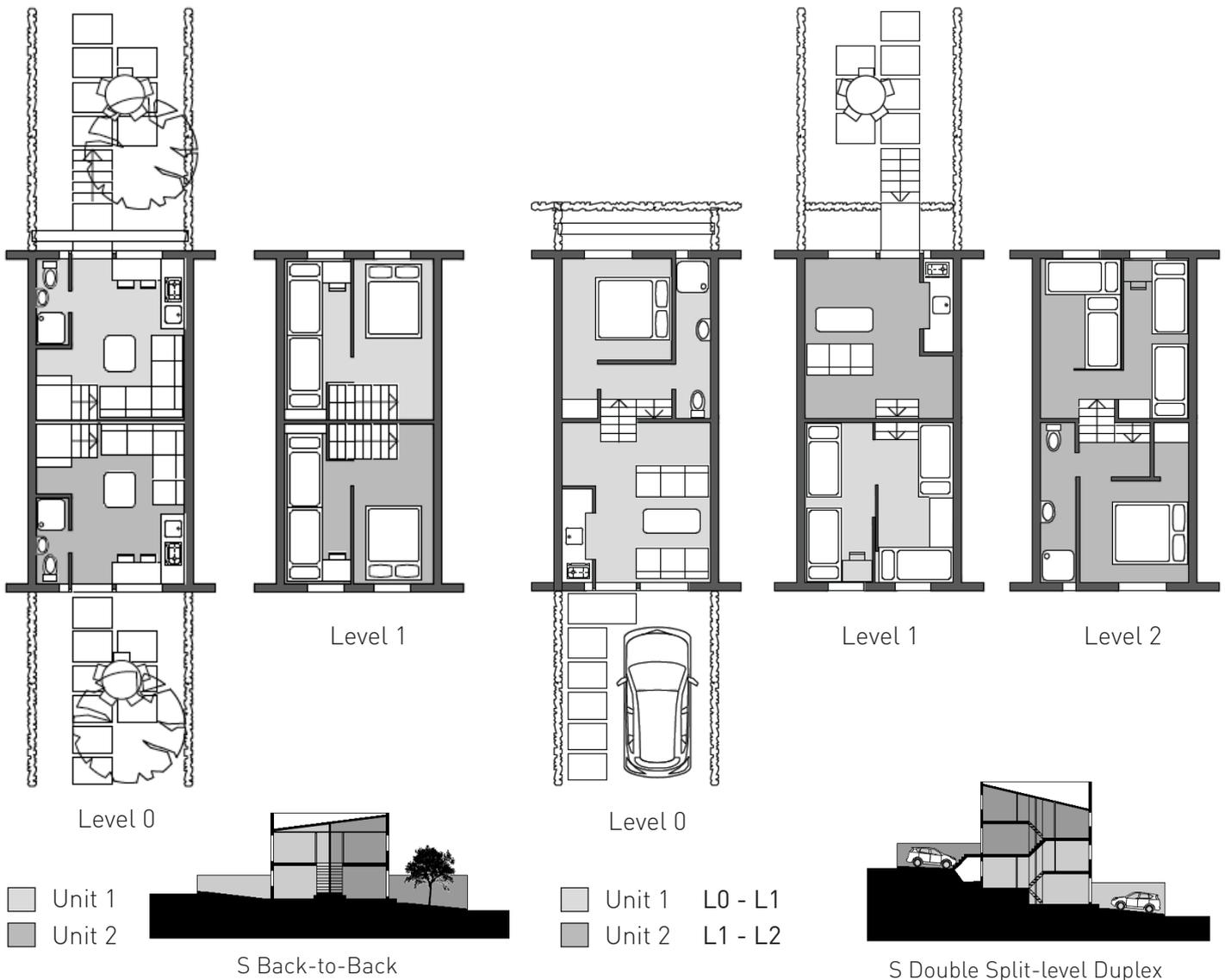
starting from
FRW **7.300.000** / unit



starting from
FRW **10.500.000** / unit

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

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



XS

starting from
FRW **9.300.000**



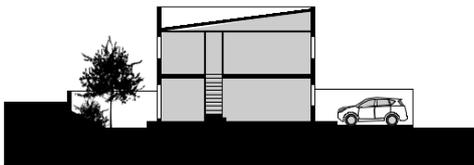
starting from
FRW **12.300.000**

XS SHELL 58m²

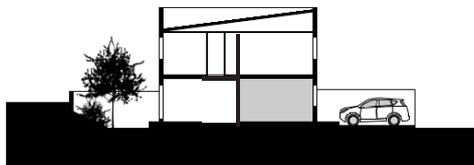
Interior Dimensions: 3.50m x 8.34m
 Room Height: 2.40m
 Walling Material: Fully Facing Modern Bricks
 Slab: Timber Floor / Maxpan between stacked units
 Ground Floor Slab: Cement Screed
 Roofing Material: Iron Sheet

XS SIMPLE DUPLEX 58m²

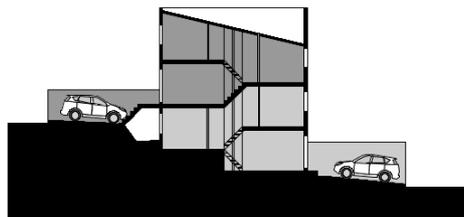
Living Room/Dining Room	19
Master Bedroom	8
Additional Bedrooms (2x)	15
Kitchen	✓
Bathroom (1x)	✓
Storage	✓
Garden	✓



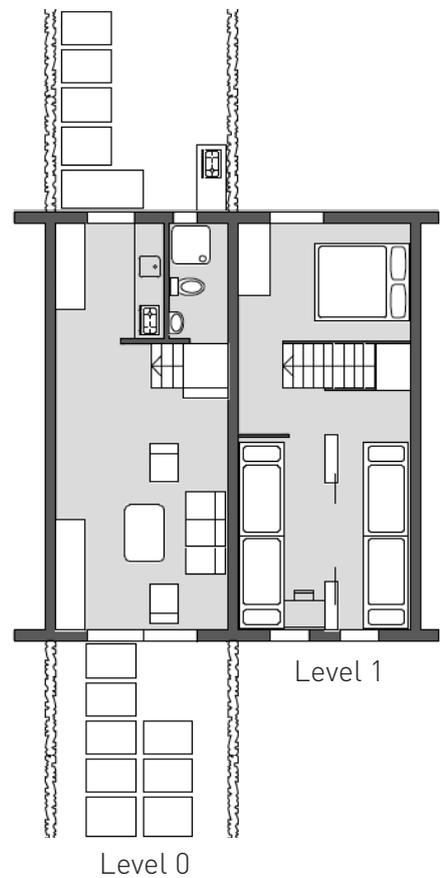
XS Simple Duplex



XS Studio



XS Double Split-level duplex





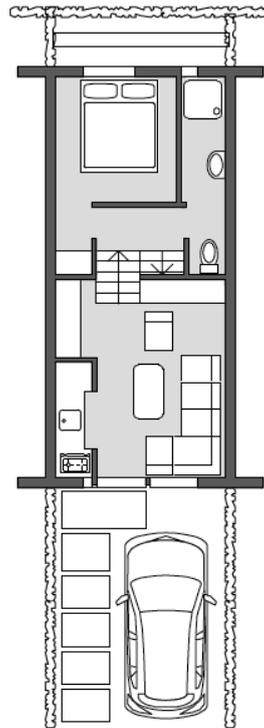
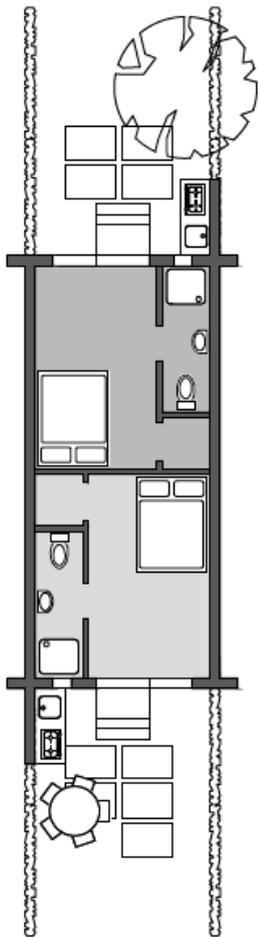
starting from
FRW **4.200.000** / unit



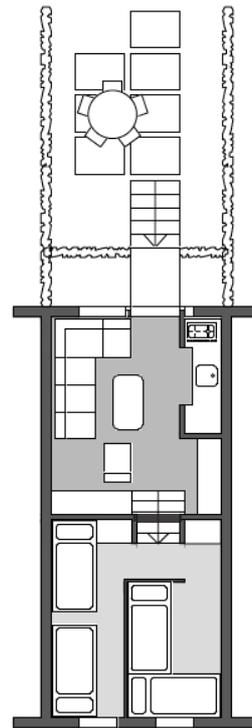
starting from
FRW **9.800.000** / unit

XS STUDIO (1 of 2 units)	14m ²
Living Room/Dining Room	11
Kitchen	✓
Bathroom	✓
Garden	✓

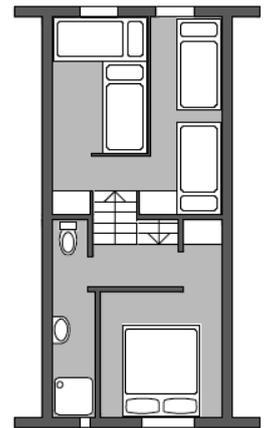
XS DOUBLE SPLIT-LEVEL DUPLEX (1 of 2 units)	43m ²
Living Room/Bedroom	12.5
Master Bedroom	8
Additional Bedrooms (x2)	15
Kitchen	✓
Bathroom (x1)	✓
Garden	✓



Level 0



Level 1



Level 2

- Unit 1 L0 - L1
- Unit 2 L1 - L2

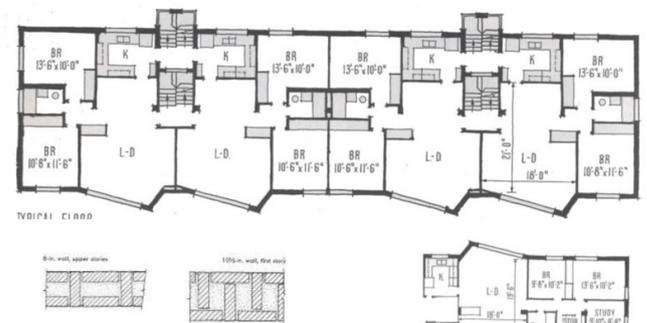
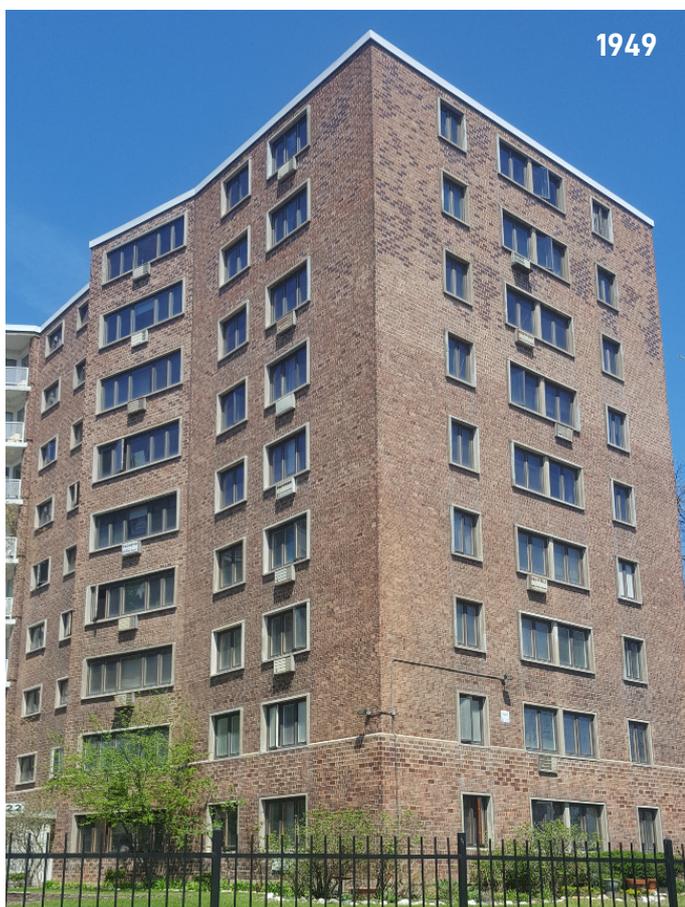


CASE STUDY

ROWLOCK BOND

ROWLOCK BOND: A TIME-TESTED CONSTRUCTION METHOD

Rowlock Bond walling is a cost-effective walling system, first popularized during the industrial revolution in the UK and later replicated throughout the Commonwealth and the US. The walling system is easily recognizable by virtue of its unique cross pattern and internal cavity wall. The cost effectiveness of the system made it a popular choice among designers of the 19th and 20th centuries, who developed a range of typologies from storied private residences to rowhouses, low-rise housing blocks and towers.



Top left: Workers' housing, Henlow UK (1801) Top right: Private house, Ontario, Canada (1856) Bottom: Lakefront Apartments and Lunt-Lake Apartments by Holsman, Holsman, Klekamp and Taylor, Chicago USA (1949, 1951)

RUSIZI MODEL BRICK DUPLEX SHOPHOUSE (2015)

SHOPHOUSE SERVES AS EXAMPLE OF ANCHOR BUILDING FOR ROWHOUSE TYPOLOGY

Area: 117 m²

Unit Cost: FRW 20 million (basic finishes)

Cost includes all features except land and engineering. Profit and labor are included.

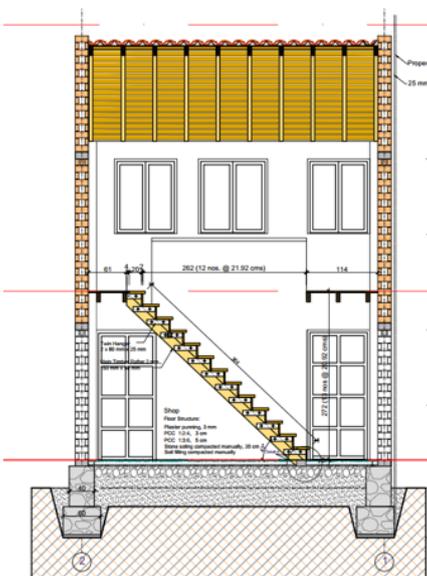
Cost per square meter: 206 USD

Elements Tested:

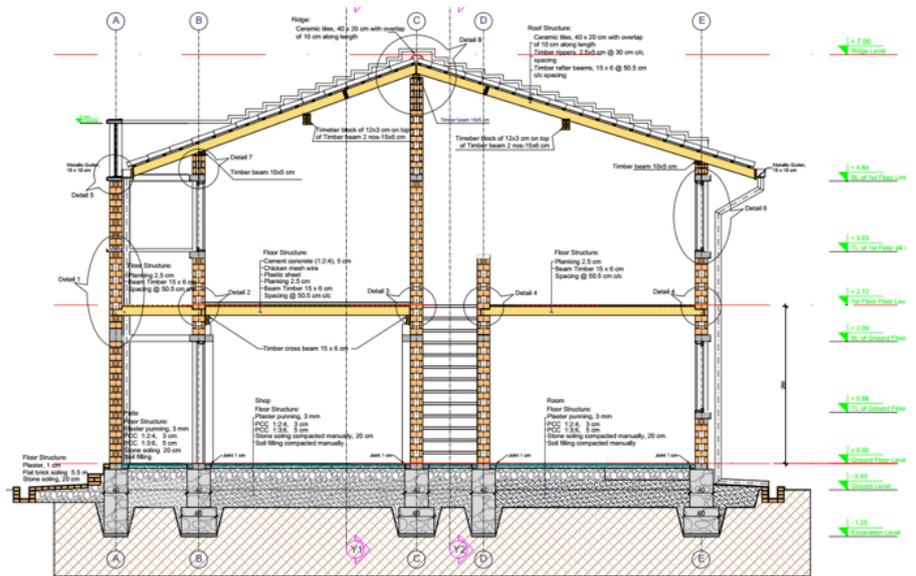
- RCC Reinforced Rowlock Bond Wall
- Timber Slab with Terracotta + Plastic Finish
- Timber Stairs
- Strawtec Partitioning Walls



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.



Transverse Cross Section



Longitudinal Cross Section

CASE STUDY

KIGALI PSF EXPO HOUSE (2017)

THE "SWISS CUBE" DEMONSTRATES THE POTENTIAL OF THE LOCAL INDUSTRY TO SUPPLY AFFORDABLE HOUSING

Area: 50 m²

Unit Cost: FRW 8 million (basic finishes)

Cost includes all features except land and engineering. Profit and labor are included.

Cost per square meter: 190 USD

Elements Tested:

RCC Reinforced Rowlock Bond Wall

Timber Slab + Timber Stairs

Innovation:

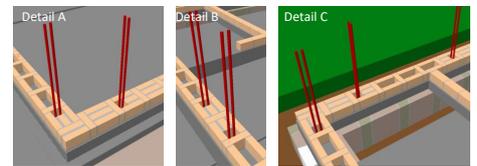
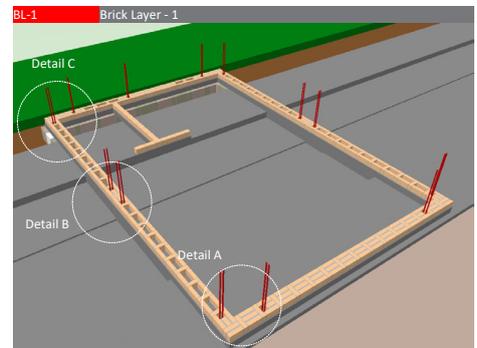
Illustrated Construction Guide (layer by layer details)



THE DEMO BRICK HOUSE FOR THE KIGALI TRADE FAIR

A Draft Construction Manual

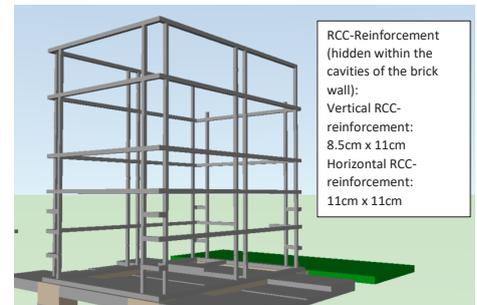
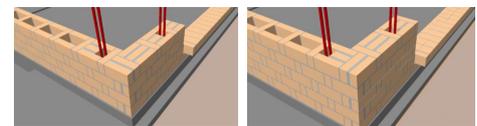
KIGALI CITY, JUNE 2017 BY SKAT CONSULTING/PROECCO



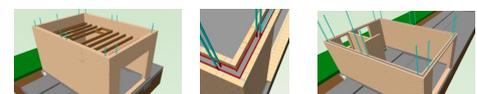
Info: The cavities for the vertical concrete reinforcement (around the vertical steel rods) need to be kept empty until the brick layer 6 is completed

Important! KEEP THE BRICK CLEAN FROM MORTAR, DON'T WASH IT WITH DIRTY (CEMENT) WATER!! REPLACE THE BRICK IF IT GETS DIRTY!!

Date: Update 1:



RCC-Reinforcement (hidden within the cavities of the brick wall):
 Vertical RCC-reinforcement: 8.5cm x 11cm
 Horizontal RCC-reinforcement: 11cm x 11cm



Info: **Important!**

Date: Update 1:

Elevation of a 5-in-1 Rental Building on a 15m x 25m plot: 280m² / FRW 45 mio



The Owners's Corner house or Shop 80-95m ² : FRW 13-15mio	Rental Unit 1 50m ² /8 mio	Rental Unit 2 50m ² /8 mio	Rental Unit 3 50m ² /8 mio	Rental Unit 4 50m ² /8 mio
---	--	--	--	--

BUKAVU CITY HALL (2018-19)

WELL-STRUCTURED DENSIFICATION CAN TRIGGER GREEN URBAN DEVELOPMENT

Area: 75 m²

Unit Cost: USD 15,000 (basic finishes)

Cost includes all features except land and engineering and terrace. Profit and labor are included.

Cost per square meter: 220 USD

Elements Tested:

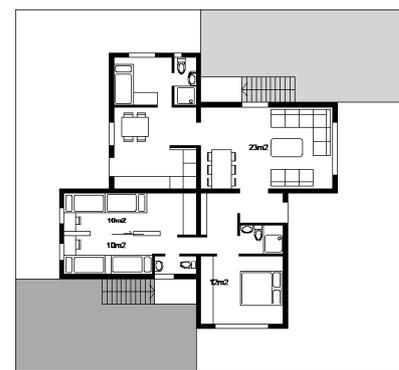
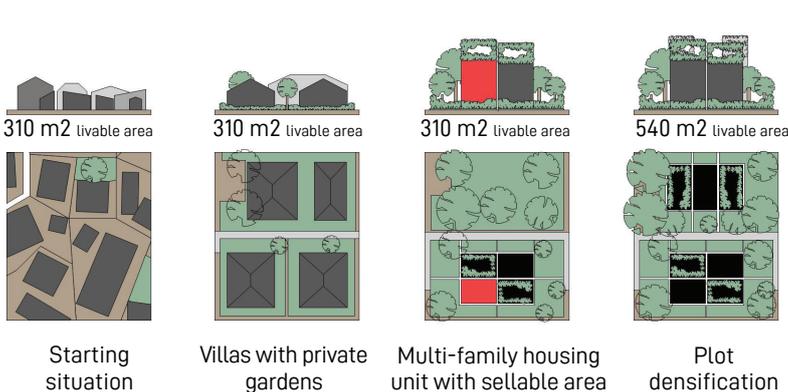
- Maxpan slab
- Sliding door roof access

Innovation:

- Rooftop terrace



The Bukavu Model House is located in the garden of Bukavu City Hall and offers investors, authorities and building professionals an example of an urban, modern, earthquake-resistant and affordable house within the city center. Designed as a terraced house for small plots, this typology allows four houses with private gardens and rooftop terraces on a 12m x 18m sized plot. This enables well-structured densification that creates green spaces that produce oxygen in otherwise dusty and muddy neighborhoods.



Pinwheel floor plan

CASE STUDY

MPAZI I MODEL URBAN MULTIPLEX (2018-20)

LOCALLY SOURCED COST-EFFECTIVE HOUSING SOLUTIONS ARE POSSIBLE WITH MODERN BRICK TECHNOLOGIES



Designed and constructed within the framework of the Swiss Agency for Development and Cooperation's PROECCO Programme (Promoting off-farm employment and income through climate responsive construction material production), the new 8-in-1 Affordable Urban Housing Demonstration Block -- built entirely with locally-sourced bricks and blocks -- demonstrates the potential of the local construction industry to deliver quality urban affordable housing solutions made in Rwanda for Rwandans.



MPAZI I MODEL URBAN MULTIPLEX (2018-20)

LOCALLY SOURCED COST-EFFECTIVE HOUSING SOLUTIONS ARE POSSIBLE WITH MODERN BRICK TECHNOLOGIES

Area: 522 m²

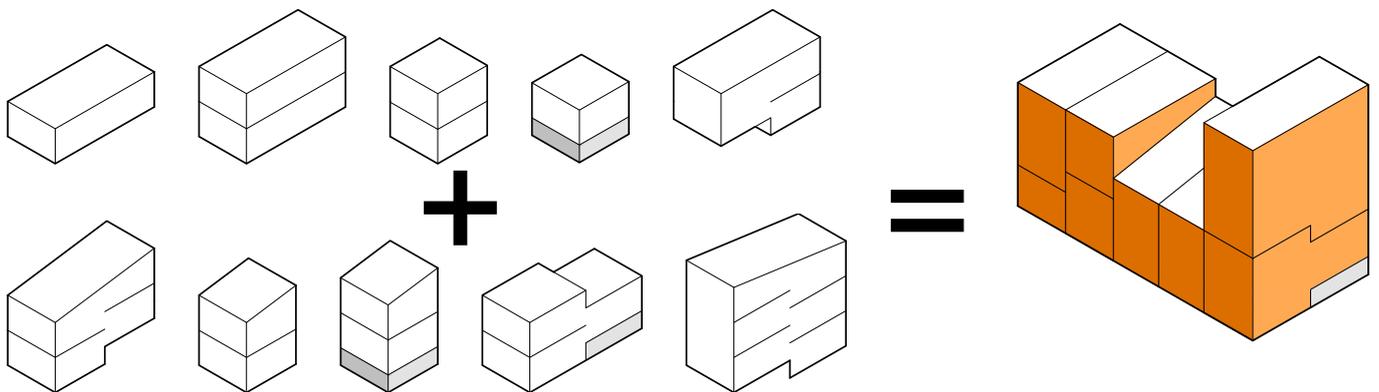
Unit Breakdown: 2-bedroom simplex (33 m²), 3-bedroom duplex (66 m²), back-to-back 1-bedroom loft (33 m²), back-to-back 2 bedroom (33 m²), 3-bedroom split level duplex (48 m²), 4-bedroom split-level triplex (122 m²), studio (16 m²)

Elements Tested:

Split level foundation
 Timber Slab - MaxSpan in-situ and pre-fab slabs
 Timber Stairs - Reinforced Concrete stairs
 Brick partition walls- timber partition walls

10 custom units with varying configuration

Split level DUPLEX section



Split level: the building responds to the sloped site by changing its standard interior spacial configuration, hence splitting the floor plan in two different levels. This solution allows the building to efficiently respond to the natural difference of levels, with a reduction of excavations and therefore a reduction of the construction cost. At the same time the split level layout allows to create ever-changing and dynamic interior spaces.

Maxspan floors and timber floors: The Mpazi project features two interchangeable floor technologies offering a financially viable solution for affordable housing while complying with the structural, safety and comfort standards required by the building code.



CASE STUDY

MPAZI II MODEL URBAN MULTIPLEX (2020-)

THE MODERN URBAN MULTIPLEX CAN SERVE AS A TOOL FOR NEIGHBORHOOD-SCALE IN-SITU UPGRADING

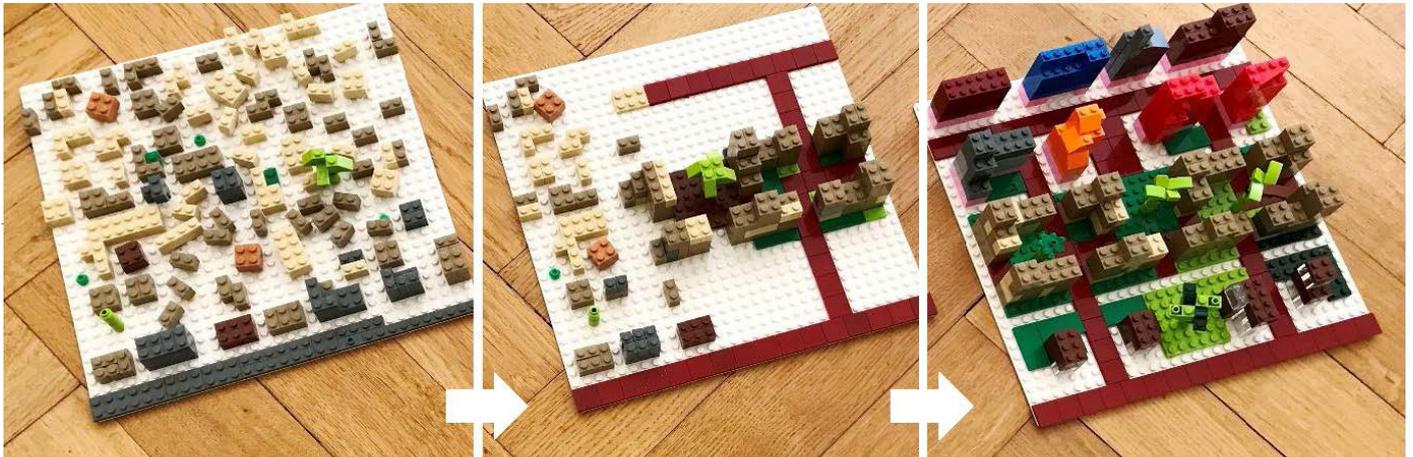


In partnership with the City of Kigali, PROECCO is implementing the participatory Mpazi Rehousing Project, which leverages existing land values and ownership to promote an in-situ upgrading process, preventing the displacement of the resident population by substantially limiting capital investment, expropriation costs and risks associated with a brownfield redevelopment projects. The approach is based on the voluntary transfer of the property from each owner to the City who, in turn, will develop and provide the owners with a more compact, modern, and safe unit of the same value.



MPAZI II MODEL URBAN MULTIPLEX (2020-)

PARTICIPATORY PLANNING AND LAND READJUSTMENT PREVENTS LARGE-SCALE COMMUNITY DISPLACEMENT



The Re-Housing project is based on participatory inclusive land readjustment done at the scale of the neighborhood. Modern brick multiplexes allow for densification that generates extra land for public and commercial spaces. Sale of commercial spaces could help finance a portion of the construction.

VISUALIZATION OF REHOUSING SCHEME AFTER LAND READJUSTMENT



ANNEX 1

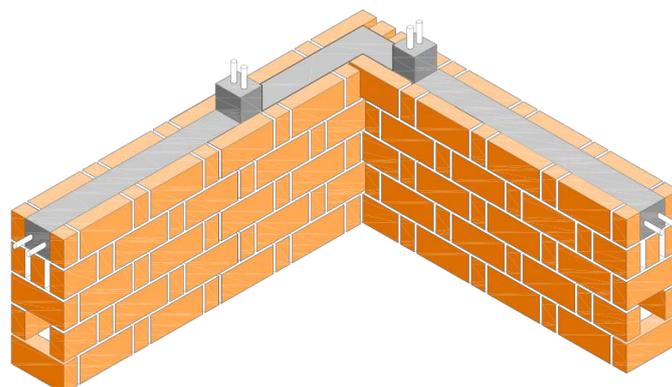
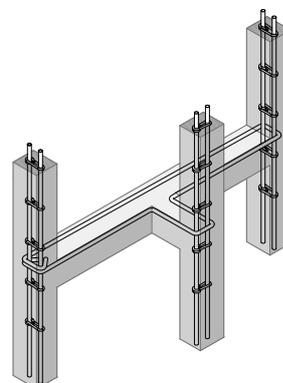
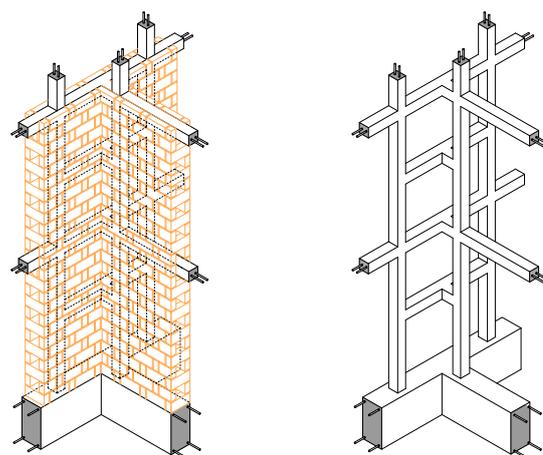
RCC REINFORCED ROWLOCK BOND WALLING SYSTEM

STRUCTURAL INTEGRITY ALLOWS FOR MAXIMUM FLEXIBILITY

Rowlock Bond walling is a cost-effective walling system for houses up to 2.5 stories. 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.



WALL REINFORCEMENT DETAILS



Top: A pair of masons lays bricks in cavity wall formation

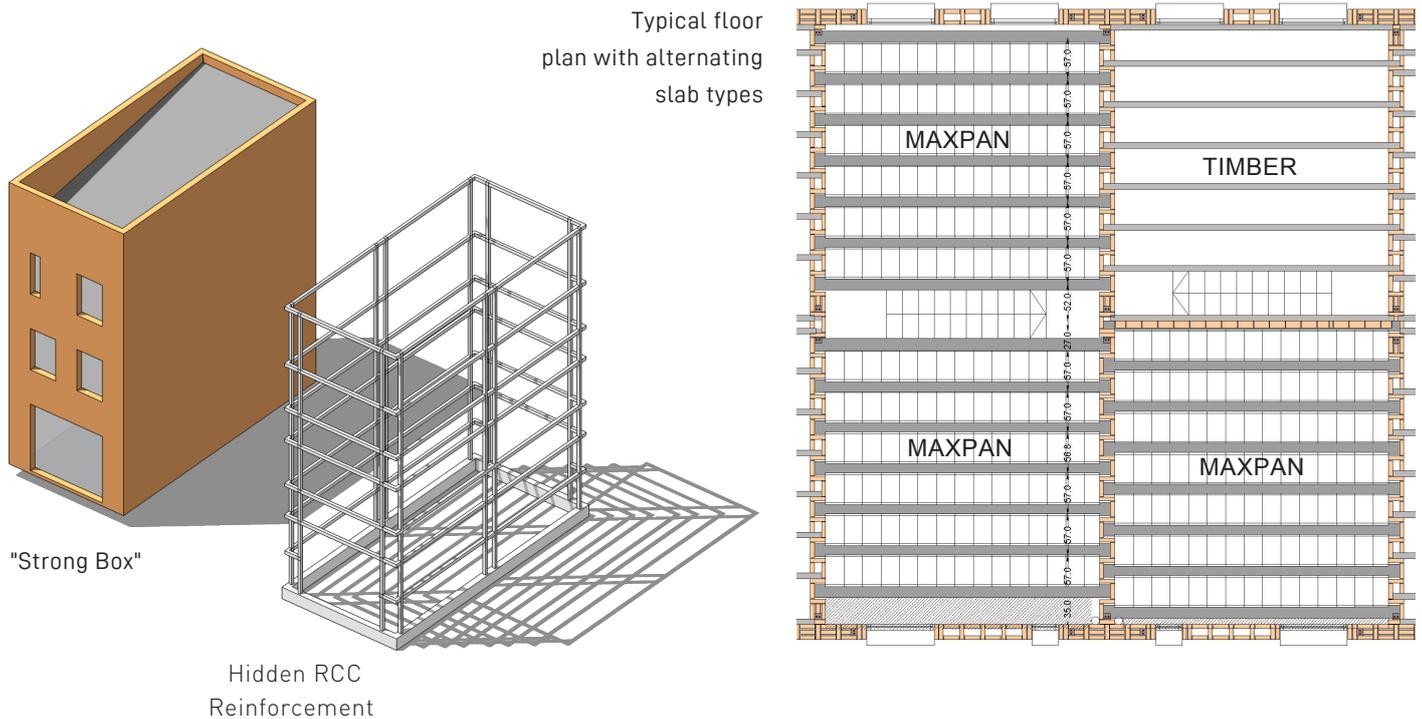
Middle: Horizontal wall reinforcement

Bottom: Design catalogue for Nepal featuring Rowlock Bond (2016)

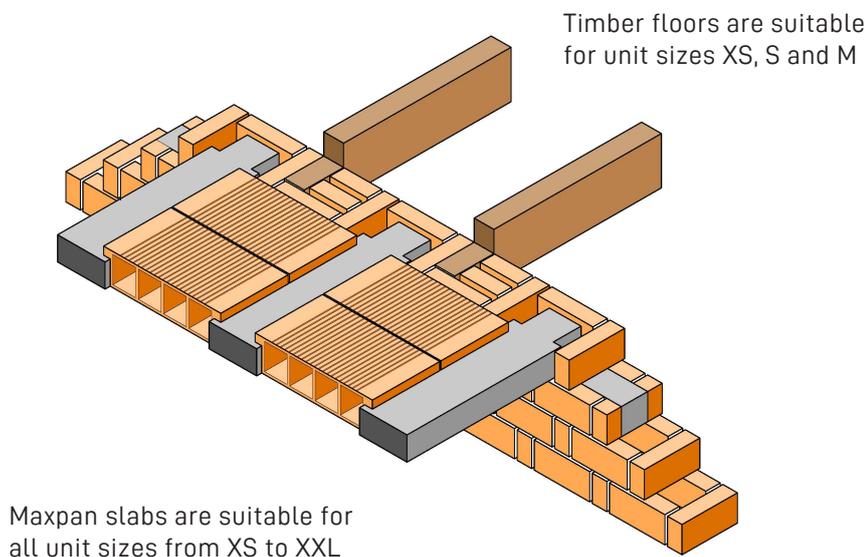
MODERN BRICK MULTIPLEX CONSTRUCTION SYSTEM

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.”



Maxpan and Timber floor slabs are customizable and fully compatible with the Rowlock Bond walling technology.

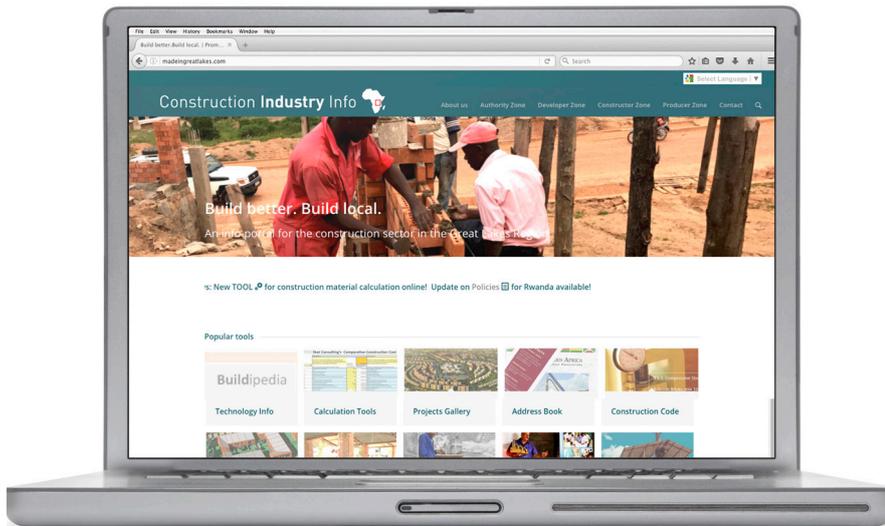


ANNEX 3

CONSTRUCTION INDUSTRY INFO PORTAL

PLATFORM FEATURES CONSTRUCTION INDUSTRY INFORMATION FOR AUDIENCES IN THE GREAT LAKES REGION

The Service Portal “Made in Great Lakes” offers access to information on various sectors and products in the Great Lakes Region relevant for building material producers, contractors, developers and authorities. Key features include real-time data on brick supply, downloadable demand and supply scenario projection tools and a list of regional construction industry events.



madeingreatlakes.com

KEY PORTAL FEATURES:

Document Library featuring urban planning codes, regulations and laws

Tenders for construction and infrastructure projects in the Secondary Cities and Districts

Training Manuals on construction material production and application

National Maps of zones suitable for semi-industrial brick production in the Great Lakes

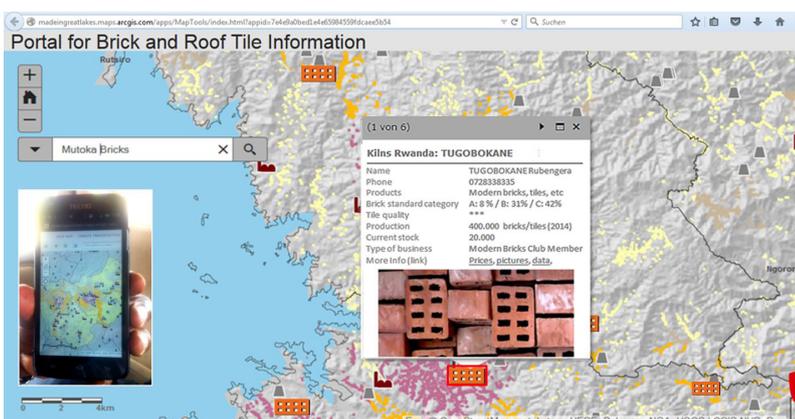
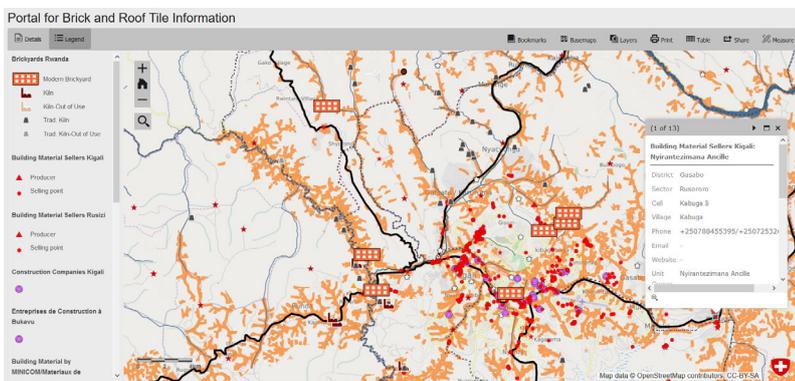
Location services allowing construction firms to locate modern brick makers near project their sites

Production Zones of Building Material Producers and Resellers displayed on a map of clay areas suitable for semi-industrial production.

Address Book of construction industry stakeholders

Statistics on regional building material production quantities

Downloadable tools used to simulate building material demand and to cost compare of construction costs

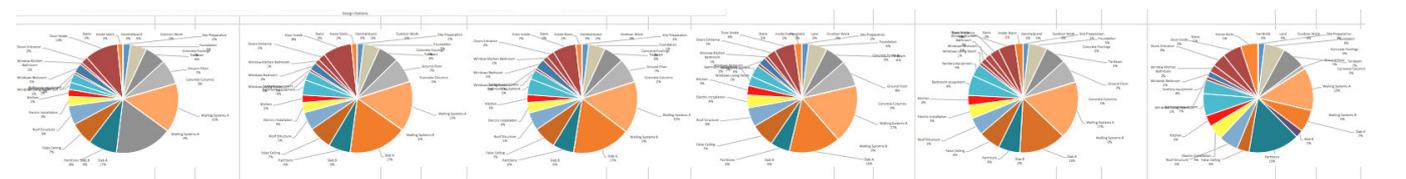


CONSTRUCTION INDUSTRY INFO PORTAL

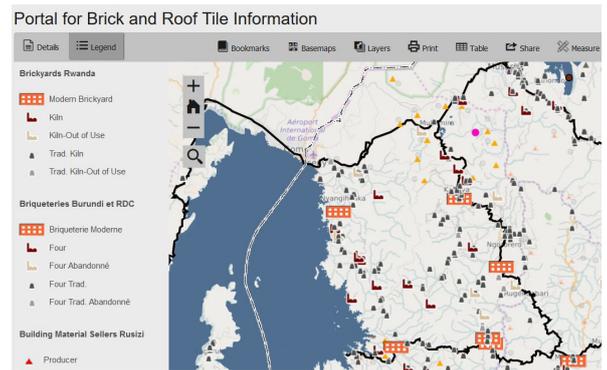
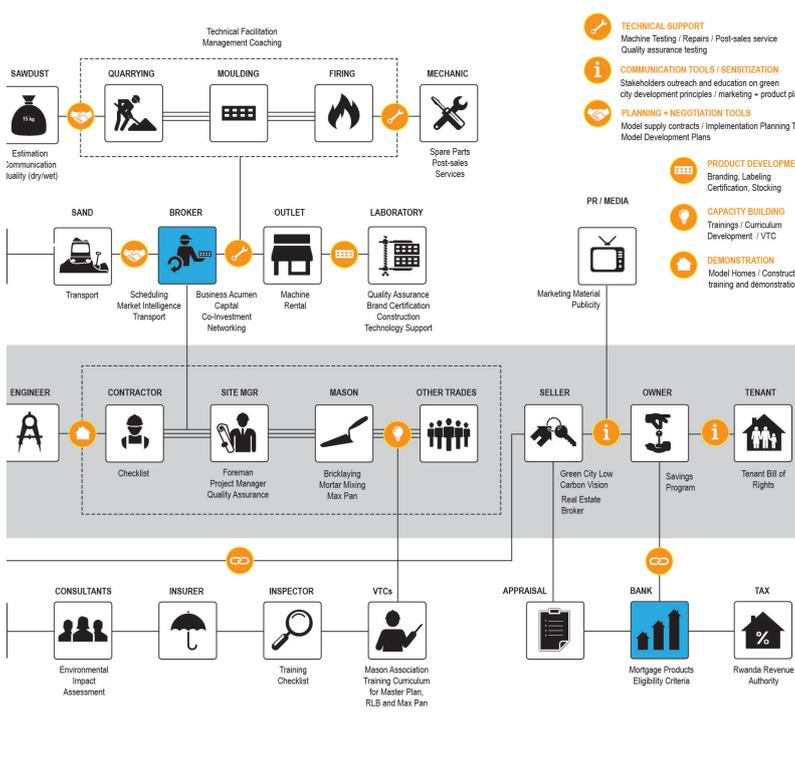
PORTAL INCLUDES REAL-TIME BRICK SUPPLY DATA, STATISTICS AND ESTIMATION TOOLS

The Portal displays maps and data collected and analysed by the programme, in particular potential sites for clayish soils extraction, and suitable fuels. One of the newest features is the Comparative Construction Cost Calculator, which allows technicians and clients to compare relative costs of different construction technologies and building materials for any given project.

SCCCC 0.1				Skat Consulting's Comparative Construction Cost Calculator				skat Swiss Resource Centre and Consultants for Development			
Design Option 1		Design Option 2		Design Option 3		Design Option 4					
M4-Size 6-in-1 Row-House Duplex Shell with 4.8m ² Reinforced Rowlock Bond Brick Wall and Max Pan Slab and Light Brick Partitions		M4-Size 6-in-1 Row-House Duplex Shell with 3.8 m ² Reinforced Rowlock Bond Brick Wall and Max Pan Slab and Light Brick Partitions		M4-Size 6-in-1 Row-House Duplex Shell with 3.8 m ² Reinforced Rowlock Bond Brick Wall and Max Pan Slab and Light Brick Partitions		M4-Size 6-in-1 Row-House Duplex Shell with 4.8 m ² Reinforced Rowlock Bond Brick Wall and Max Pan Slab and Light Brick Partitions					
Total Costs: 48,292,514		Total Costs: 48,292,514		Total Costs: 48,292,514		Total Costs: 48,292,514					
Costs/RW		Costs/RW		Costs/RW		Costs/RW					
FFW in quantities		FFW in quantities		FFW in quantities		FFW in quantities					
Costs/RW		Costs/RW		Costs/RW		Costs/RW					
FFW/month		FFW/month		FFW/month		FFW/month					



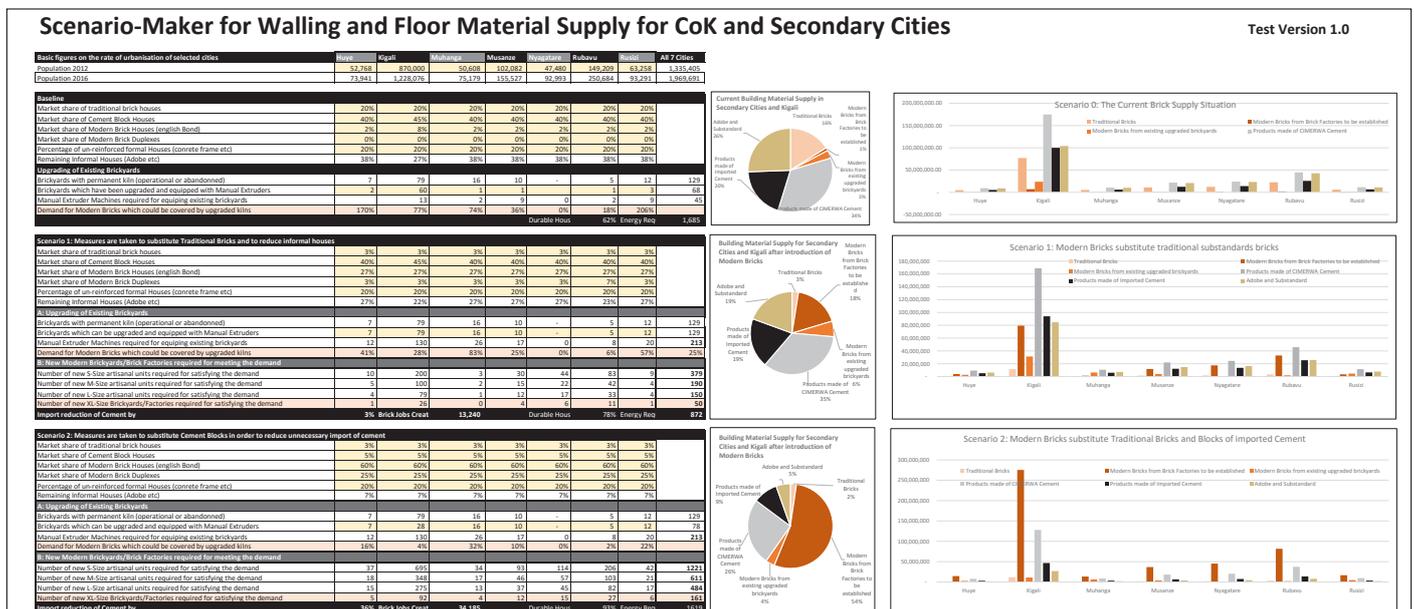
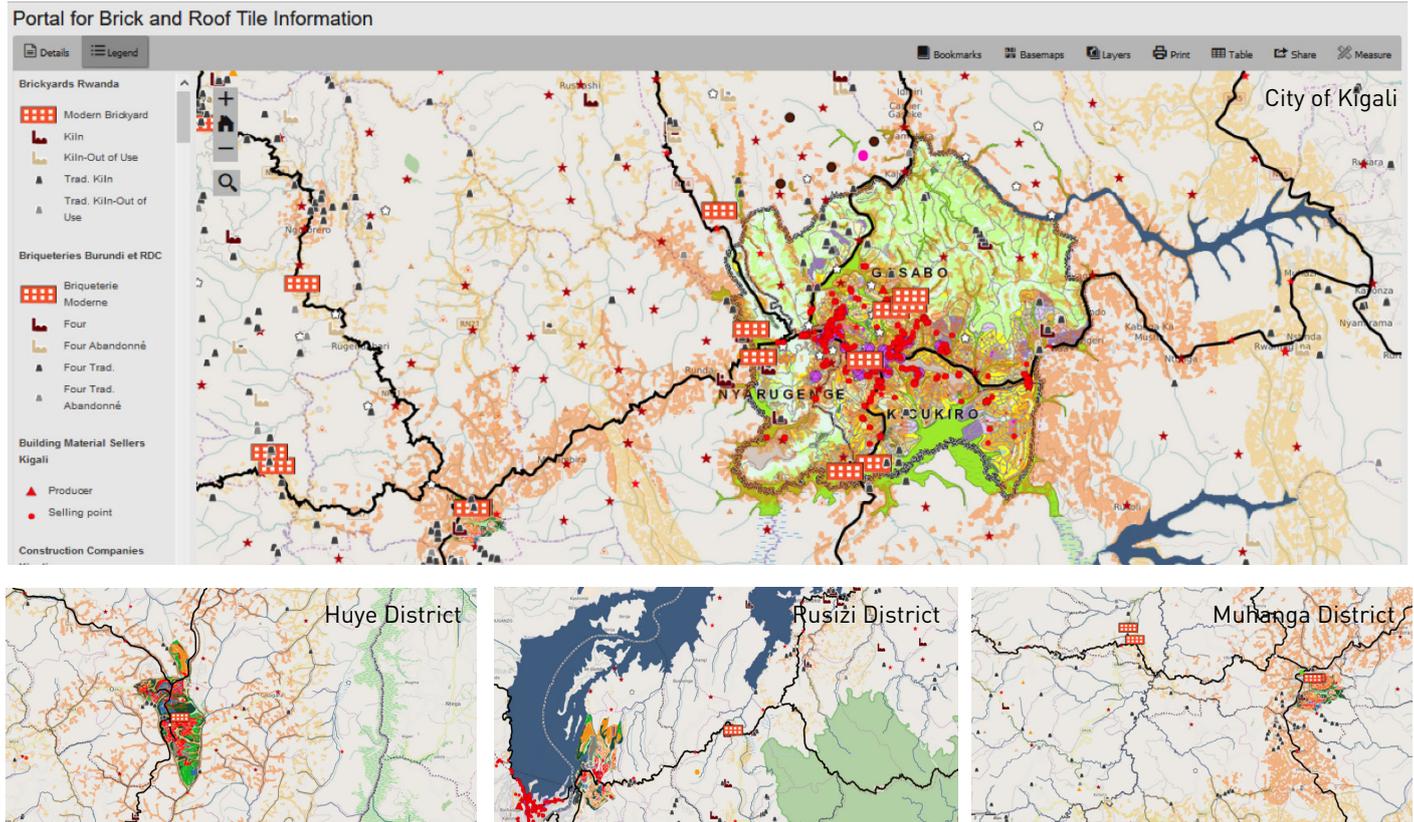
In addition to the Excel-based tools, the WebPortal features access to information about affordable housing construction value chains, training manuals for designers, planners and builders, along with a link to Buildapedia, the PROECCO project's online database of building material producers and construction techniques.



ANNEX 4 BASE MAPS FOR DEVELOPING MODERN BRICK SUPPLY FOR URBAN AGGLOMERATIONS

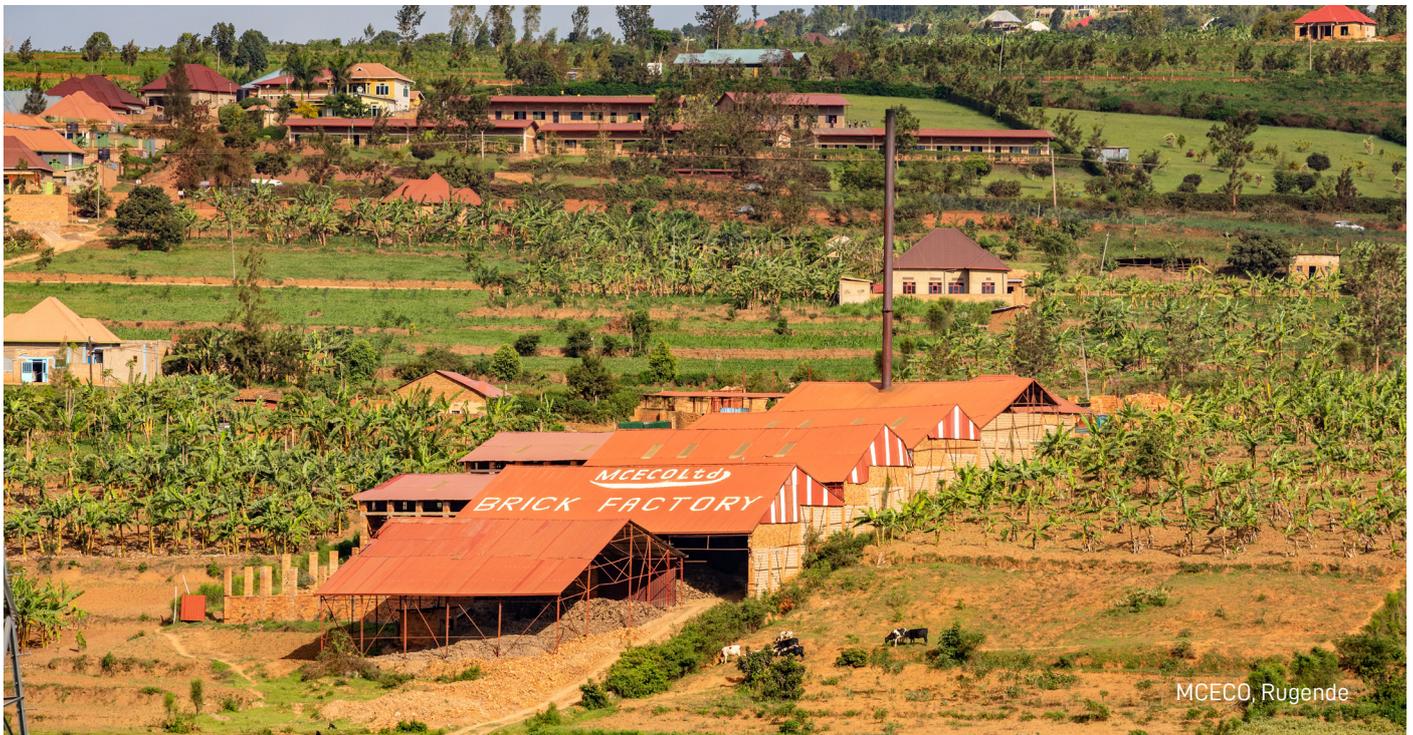
BRICK SECTOR DATA OVERLAID WITH MASTER PLAN LAND USE SPECIFICATIONS

Since 2012, the PROECCO 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.



ANNEX 5 OVERVIEW ON MODERN BRICK PRODUCTION FACILITY TYPOLOGIES

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



Top: Modern brick factory on the outskirts in Kigali in Rugende sector. Completed in 2017, the factory is the first of its kind in the Great Lakes, demonstrating that the 8-chamber ZigZag Kiln Technology is capable of producing quality Modern Bricks and Blocks (below right) on a continuous basis using biowaste fuels. Similar factories have been operationalized in Burundi and in Rwanda's Southern Province. The 4-chambered Hoffman kiln inaugurated in Rwamagana District in 2021 exemplifies PROECCO's ongoing development of cost-effective, environment friendly production technologies designed to support the local construction industry.



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