




Low-Income Housing in Santa Rosa, Philippines

Design Proposal for Improving Natural Ventilation and Cost Efficient Construction

Final Report

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Martin Schoch, Ph.D. | Unexpected Co., Ltd.
martin@unxp.asia

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EXECUTIVE SUMMARY

Santa Rosa, in the province of Laguna, Philippines, is one of the Nexus partner cities within the “Integrated Resource Management in Asian Cities: The Urban Nexus” project, financed by the German Federal Ministry of Economic Cooperation and Development (BMZ) and implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH’.

The City of Santa Rosa has requested design assistance from GIZ Urban Nexus Project to conduct a study on the design for a low-income housing project for the accommodation of government employees, and informal settlers. The studies objective is to create an architectural design of multi-residential apartment buildings in reference to an existing site under the authority of the City of Santa Rosa, emphasizing on finding suitable measures in respect to environmental and economic regards.

A study was undertaken, firstly, on the inquiry of a preliminary design scheme provided the City of Santa Rosa, and secondly, on the consideration of appropriate environmental and economic design measures regarding the local context. With understanding attained, two alternative design were proposed for deliberation and discussion with project stakeholders about environmental concerns such as and cost efficiency. Based on suggestions and comments made, one scheme was selected for development.

The final design suggests that environmental improvement can be achieved when considering building orientation, shading, natural ventilation, and flooding hazard protection. Regarding economic measures, cost efficiency can be improved by focusing on design simplification, locally practiced construction techniques and use of commonly available building materials.

INTRODUCTION

SANTA ROSA

The city of Santa Rosa is situated in the province of Laguna, Philippines. The city is predominantly a suburban residential community of Metro Manila in the western section of Laguna de Bay (Figure 1). It lies 38 kilometers south of Manila's Ninoy Aquino International Airport, connected via the South Luzon Expressway.

With a land area of approximately 54.13 square kilometers, it is the second largest local government unit in Laguna de Bay. Santa Rosa City is governed by its city mayor as the chief executive of the city, the vice mayor, and the city councilors that acts as its legislative body. The legislative body is composed of 10 regular members and representatives from the barangays (city districts) and a youth council. The western part of Santa Rosa allocates several commercial, industrial, and business areas. To the North, the city is mainly occupied by residential areas and subdivisions, schools, industrial zones, and various businesses.

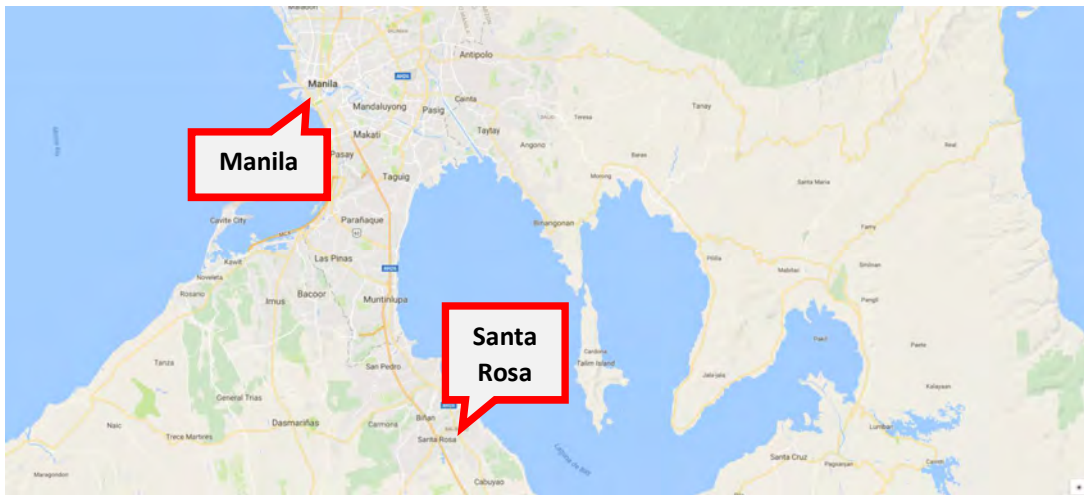


Figure 1: Geographic location of Santa Rosa, Philippines

LOCATION

The site for the Low-Income Housing Complex is situated in Barangay Labas of Santa Rosa City, located nearby Rizal Boulevard train station, about 400 meters from the Santa Rosa City Hall, and about 600 meters Northeast of the shores of Laguna Bay.

It is currently accessible from the South via Masiit Road using all common vehicles types. The site is bound on the south by private residential houses, on the North and East by rice fields and on the west by a private subdivision of residential area that is currently under construction.

The location can be found with the web-based Google map application under the geographic coordinates of 14°18'17.6"North / 121°06'27.0"East. The following map in figure 2 illustrates the geographic location of the project site, and figure 4 provides and aerial view of it.

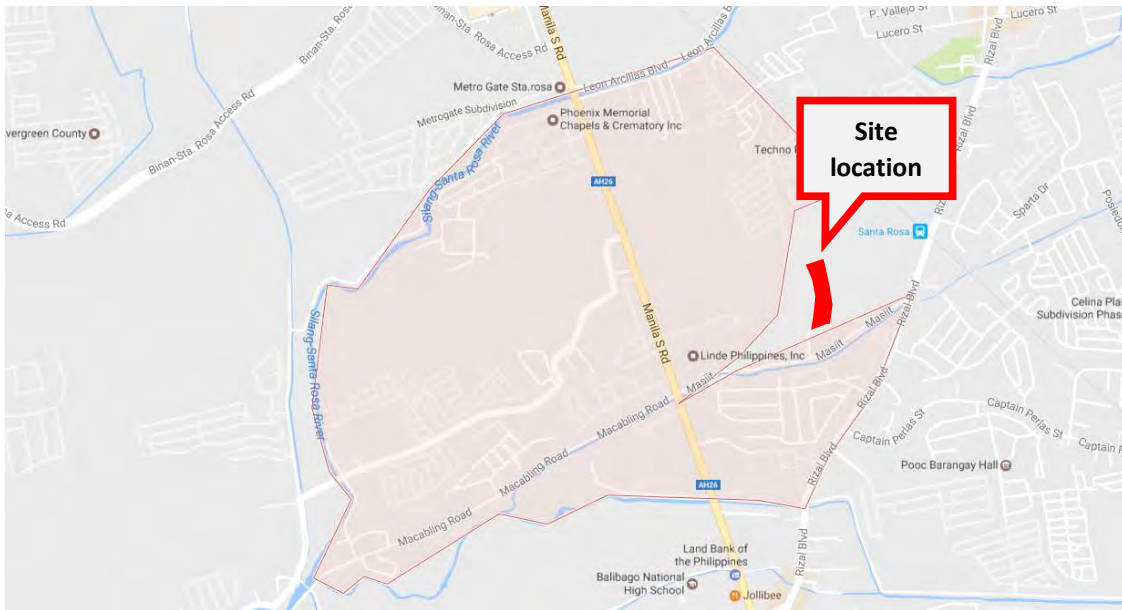


Figure 2: Geographic location of Site in Barangay Labas of Santa Rosa City, Philippines



Figure 3: Aerial view of Site Area¹

The proposed site for the low-cost housing development covers a total land area of 22,147 square meters. The property is currently unbuilt. It foresees land use conversion of its former agricultural land to residential use as part of a continuous densification in the area. Due to increased housing demand, private housing estate developments of low-rise housings are currently being realized along the East side of the property. All existing buildings, as well as the currently planned residences in the neighborhood, do not cast shadows onto the site during the day.

¹ 'Google Maps' satellite image

CLIMATE

The local climate is understood as tropical, characterized by high average outdoor temperature and continuously high humidity levels throughout the year. According to Köppen’s climate classification, Santa Rosa’s climate is understood as ‘tropical monsoon’ (Am) with two pronounced seasons: a ‘dry’ season from January to April, and a ‘wet’ season from May to December. Accordingly, the driest month of the year is March, when the Northeast monsoon prevails in the Eastern parts of the Philippines. October has the highest mean rainfall; with the Southwest monsoon bringing precipitations through heavy rainfalls, local thunderstorms, or typhoons. November to February are the coolest months, while April to June are the hottest months.

Sun Exposure

Located near the equatorial belt, sun radiation is high throughout the year. With a global horizontal radiation of up to 780 Wh/sqm, buildings must consider appropriate shading, especially during mid-day to afternoon hours along South and West building orientations.

Temperature and Humidity

Information on the local climate condition has been retrieved several internet data bases^{2,3}. The cities mean annual temperature is 27.6 °C and is considered as relatively cool due to the cities elevation and favorable airshed condition. The warmest month is May with an average of 30.0 °C while the coolest month is January with an average temperature of 25.0 °C⁴. Figure 5 illustrates the monthly recorded high, low and mean temperatures in Santa Rosa during 2016.

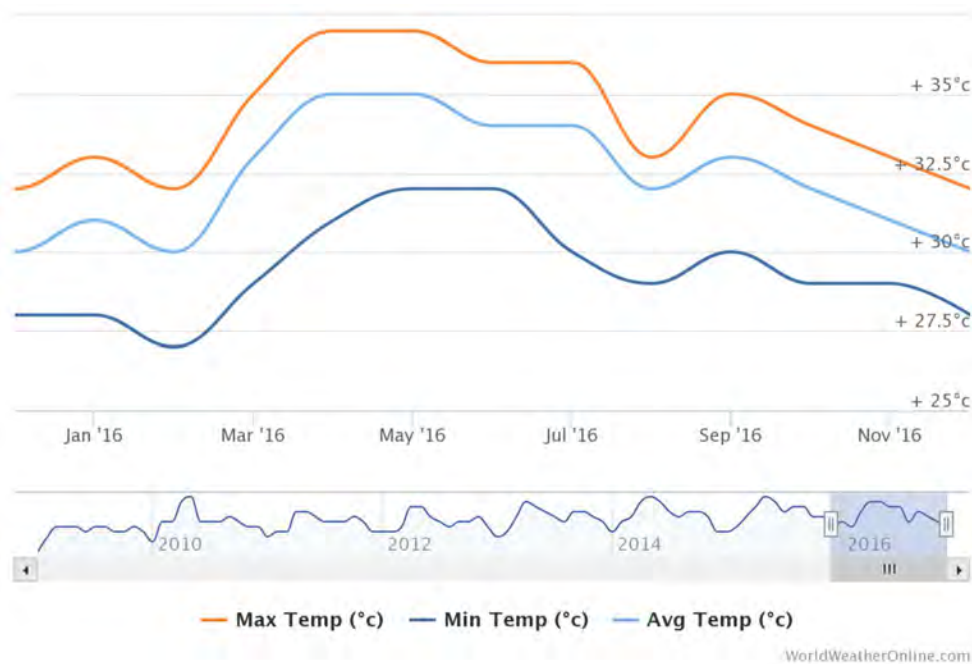


Figure 4: Santa Rosa Laguna / Annual Max., Min and Average Temperature (Celsius Degrees/ 2016)

Average relative humidity is roughly 80% in Santa Rosa, making the city somewhat cooler than the Metropolitan area of Manila with an average relative humidity of 81%. Figure 6 illustrates the

² World Weather Online (<http://worldweatheronline.com>)

³ ClimateData.Org (<http://en.climate-data.org>)

⁴ City of Santa Rosa, (<http://santarosacity.gov.ph/about-sta-rosa/climate/>)

monthly recorded humidity levels and the amount of cloudy days in percentages in Santa Rosa during 2016.

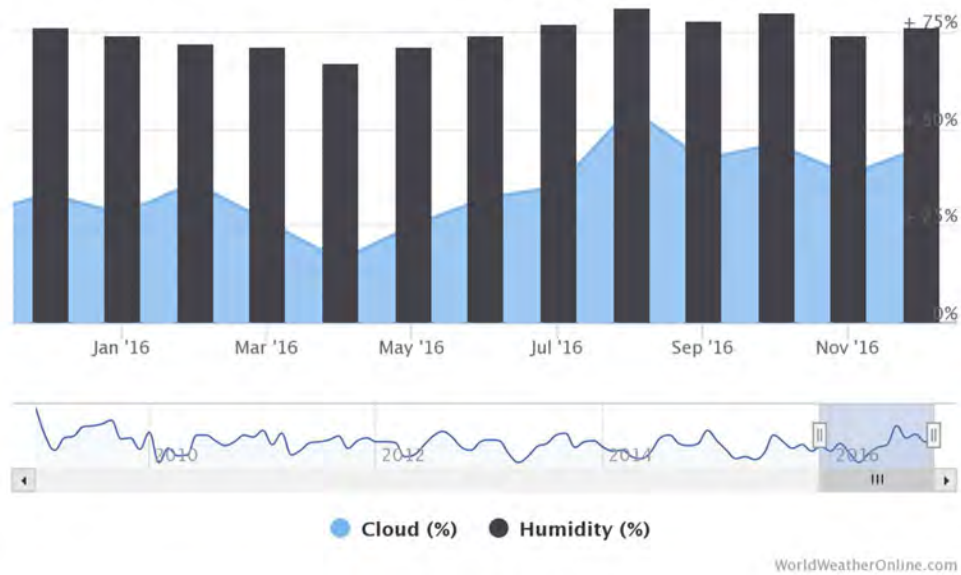


Figure 5: Santa Rosa, Laguna / Cloudy Days, and Humidity Levels per month (2016)

Wind Speed and Direction

Northeasterly winds prevail during the months of October through February. Winds come from the Southeast during March and April. Southerly winds prevail during May while from June through September. The average speed of winds is 5 kilometres per hour.

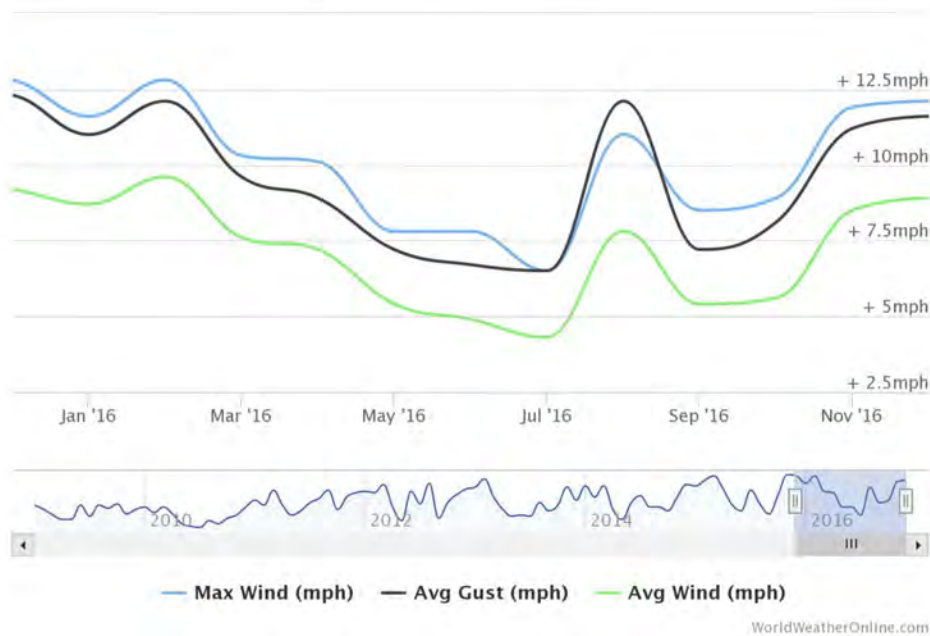


Figure 6: Santa Rosa Laguna / Average and Max Wind Speed and Gust (mph)

Precipitation and Rainfall Intensity

The annual average rainfall is about 1,950 millimeters. The maximum rainfall occurs in October while minimum rainfall is measured about 10 millimeters at the beginning of the year. Though the municipality is located in a region where typhoons occur, Santa Rosa is hardly affected due to its surrounding mountain areas. The following figure 8 provides an overview over local precipitation amount in 2016.

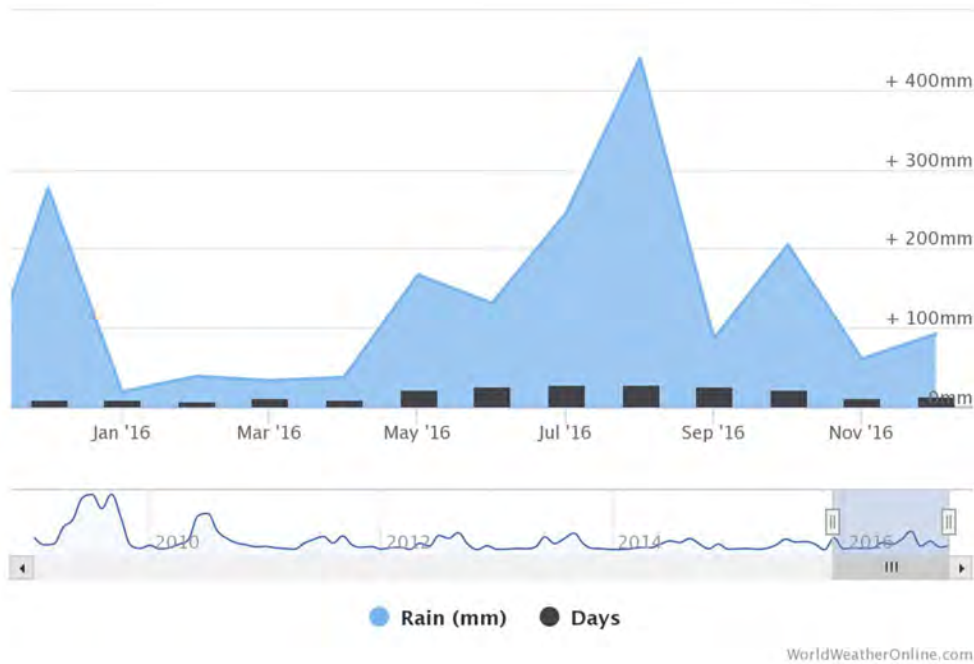


Figure 7: Santa Rosa, Laguna / Average Rainfall Amount (mm) and rainy days

GEOGRAPHY

According to a conducted geohazard assessment ⁵, the foreseen site can be considered being within low to medium risk zone regarding earthquakes and flooding. Considering its distance from the active earthquake generating structures, the site could be considered suitable for development. However, proper design and engineering of the building including choice of good quality construction material must be strictly implemented.

Earthquakes

The site location is within the classified residential district of the approved City Zoning of Santa Rosa. Yet, lying close to several active earthquake generators, earthquakes resulting from fault movements are an unavoidable and unpredictable phenomenon the place could experience. Located on a flat terrain, with underlying of layers of unconsolidated soils and sediments, building foundations must lie on hard ground formation to avoid soil settlement.

Flooding

The project is located on flat terrain with an elevation of ±7 meters above sea level and falls under moderate to high susceptibility to flooding by Mines and Geosciences Bureau. Elevating the project site may lessen its susceptibility to flooding. Maintenance and cleaning of drainage systems not only in the project site but also in the main drainage outlet should be given full consideration by the home

⁵ Geohazard Assessment Report, Hernani I. Bayani

owners/developer to prevent increase siltation, and clogging of waterways which, will eventually lead to localized flooding.

Urbanization

Continuous urbanization in this part of the region resulted in the near depletion of tropical rainforest in mountainous areas and low-lying plains. In these areas, only limited varieties of small diameter trees abound along the upstream banks of the major rivers and tributaries of the highlands. At present, around seventy percent of the low-lying areas occupied are by residential houses, commercial and industrial establishments and rest are covered with agriculturally used land.⁶ The transformation from agricultural land into urbanized areas are continuing.

POPULATION

According to Philippine Statistics Authority, the city's population record stated 353,767 inhabitants in 2015. The population of Santa Rosa is fast-growing, over the last 25 years its growth rates were between 2.4-7.3%.

Year	Population	±% p.a.
1990	94,719	—
1995	138,257	+7.34%
2000	185,633	+6.52%
2007	266,943	+5.14%
2010	284,670	+2.37%
2015	353,767	+4.22%

Figure 8: Population of Santa Rosa (1990-2015)⁷

Santa Rosa's population density averaged of 1,749 and 3,351 persons per square kilometer of land area in the year 1990 and 2000 respectively⁸. In 2012, Santa Rosa had a population density of 5,226 persons per square kilometer of land area, reaching a population density comparable to Bangkok with around 5,300/km².

LOW COST HOUSING PROJECT

It is assumed that the evolving status of Santa Rosa as the location of middle to high-class developments will further add to the increase in population. This means that, as the population of the city continuously increases, the competition for the demand of commodities like land will increase as well.⁹ A present aim of the city is thus to ensure sufficient affordable housing possibilities for citizens with lower incomes, particularly in respect to the number of low-income government employees in Santa Rosa currently in need for proper accommodations.

In addition, many informal settlers, allocating their shanties along riverbanks and unoccupied land stretches, are of concern to the city. Not only are the location of their illicit settlements considered as high risk areas that are vulnerable to flooding, they also face significant water pollution from solid and liquid (sewage) wastes from the settlers and communities nearby.

The city is considering to support the realization of 'multi-story apartment-style' residences for informal settlers and government employees (ownership of the property) in such a way that it would fit the financial capacities of the beneficiaries with consideration to the standards set by the National

⁶ Geohazard Assessment Report, Hernani I. Bayani

⁷ Source: Philippine Statistics Authority

⁸ Philippine Statistics Authority

⁹ City of Santa Rosa, (<http://santarosacity.gov.ph/about-sta-rosa/climate/>)

Housing Authority. However, intensive education maybe necessary for the adoption of the 'new' community with the integration of the nexus approach¹⁰.

Yet, another consideration is the investment of a vacuum sewer system for the planned housing project to prevent soil and groundwater pollution from leaching sewage of traditional septic tanks. It is anticipated that such would not only require training of the engineering staff for the operation and maintenance of the system, but also a general mind-shift of the informal settlers; i.e. willingness to embrace new ways of living and system technology (vacuum system)⁵. According to studies of the local Nexus team, expected benefits of a resettlement of informal settlers and use of a vacuum sewer system are as follows:

- ✓ Transfer of informal settlers from high risk / flood-prone areas to safe and environmentally-sound and sustainable community
- ✓ Pollution decrease of surface waters/river systems caused by indiscriminate throwing of garbage and direct discharge of sewage into water bodies.
- ✓ Reduce water consumption from toilet flushing (vacuum sewer system use less water as compared to manual or automatic toilet flushing).
- ✓ Reduced environmental and health risks from contaminated groundwater and polluted rivers
- ✓ Considerable savings in construction costs of the vacuum sewer system.

SCOPE OF WORK

The "Integrated Resource Management in Asian Cities: The Urban Nexus" implemented by GIZ is consulting a new building project for a multi residential low-cost housing in Santa Rosa, Philippines. The project owner is the City of Santa Rosa, with its building department as planning team of the project.

Per provided Terms of References of the GIZ Nexus Project, the scope of work of this study is to collaborate in the planning and implementation of an environmentally friendly low-cost housing project for government employees of the city and informal settlers. At the beginning of the consultation in January 2017, a preliminary design of the project, including a masterplan and designs of two building types were provided. Unexpected Co., Ltd. was asked to evaluate the design proposal and offer an architectural design solution considering environmental and economic improvement.

Divided into the following steps, the suggested work phases are described as follows:

- Analysis of existing preliminary design
- Review on suitable environmental and economic design measures
- Schematic Design
 - Proposal of two alternative schemes including a Masterplan, building design plans and apartment designs
 - Presentation to the Authorities at the City Hall of Santa Rosa and GIZ. Discussion, and consideration of comments and suggestions for inclusion into the final design scheme for the entire site as well as for the individual buildings.
- Final Design
 - Preparation of drawings set of architectural design scheme including:
 - Building floor plans, building sections and elevations, apartment units' floor plan,

¹⁰ Erlinda C. Creencia, Urban Nexus Project, City of Santa Rosa

- Preparation of Master-plan including buildings, street -, and landscaping on the entire property.
- Suggestive layout planning for waste water system per new architectural design scheme.
- 3D views of buildings
- Summary and Recommendation

EXPECTED RESULT

It is expected that the collaborative study is leading to the development of an architectural design solution to improves the addressed environmental and economic design measures progressively by creating:

- A. Well developed, yet affordable housing units to their future owners
- B. Sustainable building construction solution considering material use, as well as appropriate construction technique
- C. An environmentally responsive design solution considering the climatic context of the site.
- D. Pleasant yet functional outdoor environment.

ANALYSIS

EXISTING DESIGN

An existing preliminary design has been provided for the inquiry of usage and function, building operation, selection of construction method and selection of materials based on provided planning documents.

The current design, provided by the City of Santa Rosa, foresees about 312 (13x6x4) units for government employees, and 304 (19x4x4) units for informal settlers with a total of 45,166 sqm floor area that are distributed over 10 buildings with five floor levels each. There are two building types; one that foresees the apartment units of 33 sqm for government employees and, a second that provides for the apartment units of 24 sqm designated informal settlers. The separation into two different building types for the two resident types is intended to avoid later conflicts between them.

In the Masterplan, one main access road, crossing the property from South to North, is connecting the land to the existing road infrastructure. All buildings are situated alongside that road, making the buildings orientation to be primarily towards North - South orientation. This means that the elongated façades of the buildings are exposed towards East - West orientation. Between some buildings, a total of 48 (3*16) parking spaces and two multipurpose outdoor areas are foreseen. Further, a vacuum sewage system, has already been considered and a location for a building unit that houses the sewage pumps allocated on the masterplan.

The two building types for government employees and informal settlers are similar in their overall appearance, with a L-shaped floor plan layout and a centralized corridor to accesses the individual housing units. The first-floor level of the building units remains unbuilt, with the allocation of the residential units starting from the second floor upwards. Currently no additional functions, such as are garbage collection or technical areas are foreseen.

The overview of the properties calculated land use is shown in figure 5, with the data is taken from provided drawing documents. It should be noted that the area of the unutilized first floor level was not included in the gross floor area calculation.

	Type	Area [m2]	Percentage
Property Size		22,147.00	
Gross Floor Area (All Floors)		45,166.00	100.0%
Footprint Area (1st Floor)		11291.50	25.0%
Buildings Government Employees		16,929.00	37.4%
Buildings Informal Settlers		12,420.53	27.5%
Green + Parking		10,688.00	23.66%
Road		4,245.00	9.4%
Sewer		884.00	1.7%

Figure 9: Existing Design, Overview Land Use

With a total amount of 616 apartment units the settlement must be considered as high density, making it vulnerable to social conflicts. Considering an average amount of 3 residents per apartment unit, a total of 1,848 people, or a population density of approx. 82,000 p/km², respectively is to be

assumed. Focusing on environmental and economic condition of the design, several qualitative design judgements were made to help understanding the designs baseline condition and its potential for improvement.

In the following positive and negatives remarks have been listed per their expected environmental impact:

- + Separation into building types avoid social conflict
- + Centralized corridors minimize infrastructure

- Building orientation is disadvantage due to sun path exposing large amounts of the building facades towards East and West
- Natural ventilation of corridor paces units does not seem supported
- Natural ventilation of individual apartment units does not seem supported
- Position of bath rooms do not allow for adequate ventilation
- Bathroom position make units inflexible in terms of usage

Considering cost for building construction, the following positive and negative have been identified:

- + Rectangular, simple building designs
- + Repetitive apartment units
- + Repetitive floor levels

- Amount of vertical staircases
- Pathways (bridges) between neighboring buildings
- Increased buildable floor area (unutilized 1st floor level)
- Increased construction effort due to empty 1st floor level
- Increased amount of installation shafts due to separate allocation of plumbing fixtures

ENVIRONMENTAL AND ECONOMIC DESIGN MEASURES

ENVIRONMENTAL CONTEXT

CLIMATE RESPONSIVE DESIGN MEASURES

In combination with existing weather data, general suggestive design strategies for the buildings design can be deduced using a bioclimatic chart and respective zone definitions. The bioclimatic chart in figure x illustrates existing temperature / humidity levels (green dots) in relation to the climatic comfort zone (blue polygon).

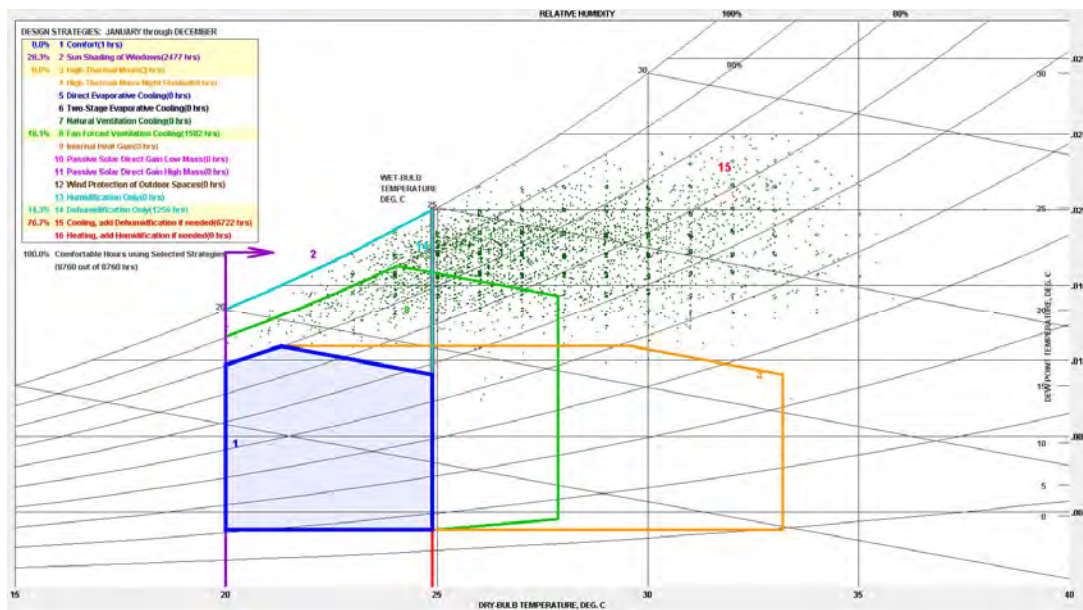


Figure 10: Bioclimatic Chart¹¹ for Santa Rosa (Manila Airport weather station)

Accordingly, climatization by predominantly using cooling and dehumidification is essential throughout the year. Additionally, sun shading (green polygon) and fan forced ventilation cooling (orange polygon) is supportive when temperature/humidity levels are close to comfort zone levels. In response to the design strategies that were retrieved from the bioclimatic chart, appropriate measures for building designs were deduced that were define as follows with the tagged measures deeming suitable for the specific housing project:

- ✓ Good natural ventilation can help eliminate air conditioning in warm weather if windows are well shaded and oriented toward prevailing breezes
- ✓ Building sizes should remain small as excessive floor areas increase cooling energy demand
- ✓ Long narrow floorplans can help maximize cross ventilation in hot humid climates
- ✓ Use of plant materials around the buildings and/or on building facades (trees, bushes, ivy covered walls), especially on the West to minimize heat gains
- × Radiant barriers, such as reflective coating help reducing radiant heat gain through the roof
- ✓ Buildings raised above the ground help to avoid dampness and maximize natural ventilation
- × high performance (low E, insulated frames) glazing to reduce solar heat gains

¹¹ Source: 'Climate Consultant' software, version 6.1

- ✓ Minimize or eliminate west glazing to reduce solar heat gain in afternoon hours
- ✓ Operating cooling temperature adjustment according to building usage
- ✓ Facilitate cross ventilation, locate doors and windows on opposite sides of buildings with larger windows facing upwind if possible
- ✓ Window overhangs or operable sunshades can reduce air conditioning
- ✗ Raise indoor set point temperature of indoor air-conditioning to reduce air conditioning consumption
- ✓ On hot days, ceiling fans and indoor air movement can make it seem cooler by 2-3 degrees Celsius or more. Thus, less AC is needed
- ✓ Use light colored building materials and cool roof with high emissivity to minimize conductive heat gains
- ✓ Screened porches and patios can provide passive comfort cooling by ventilation in warm weather
- ✓ Orient most glass to the North, shaded by vertical fins, because there are essentially no passive solar needs
- ✓ Warm humid climates have openings protected by overhangs and verandas
- ✓ Passive homes in hot climates use light weight constructions openable walls and shaded outdoor porches, raised above ground.

With natural ventilation being a possible, cost efficient way of reducing the need for cooling, the following chart in figure x illustrates the existing annual wind directions and strength as measured in relative distance to the site. The graphic indicates that winds primarily blow in East to West and West to East direction.

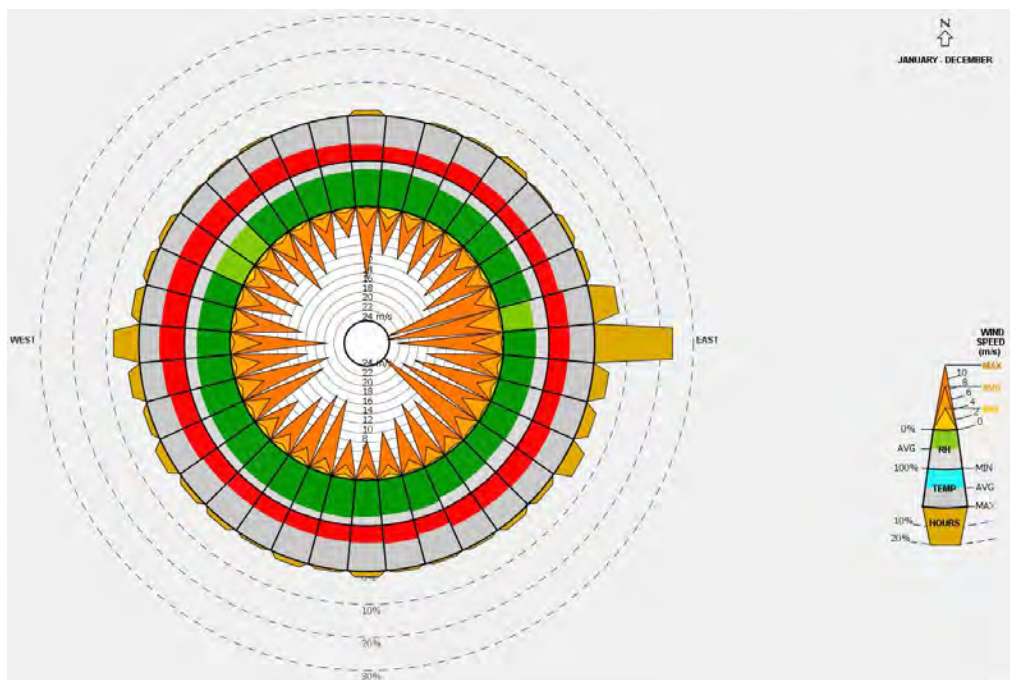


Figure 11 Annual Wind directions and strength for Santa Rosa (Manila Airport weather station)

Natural ventilation for buildings or building units can be realized when allowing for cross or stack ventilation. Cross ventilation occurs when existing exterior winds are channeled through interior spaces, thus ideally requiring for entry, and exit points. In case wind directions lead directly towards

the openings cross ventilation can be realized more easily. If not, existing exterior wind can be guided via wind traps or blocks.

ECONOMIC CONTEXT

'LOW COST' BUILDINGS

In Philippines, the housing index shows the maximum and average cost per square meter to construct a new building, including building system such as electrical, mechanical, plumbing and others¹². Accordingly, while construction costs have been rather fluctuating recently, they have demonstrated a tendency of continuous growth over the last 10 years. Figure 9 shows the maximum and average of cost per sqm, as well as a tendency from 2008 to 2016.

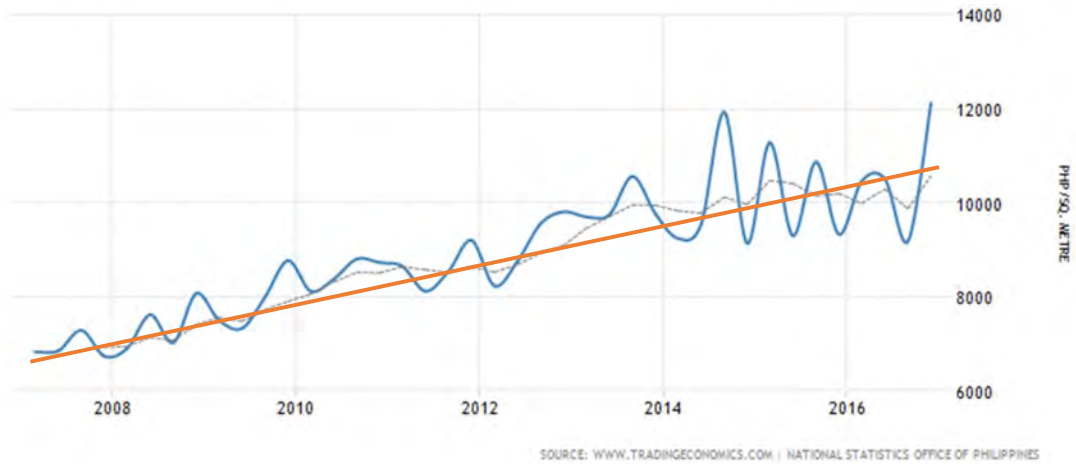


Figure 12: Philippines Maximum (Blue), Average (Black) Construction Cost & Tendency (Orange) between 2008-2016

Considering the rate of 'low cost' constructions, figure 10 suggest such to be roughly 10 % below the trend, however, such consideration must be understood as vague.

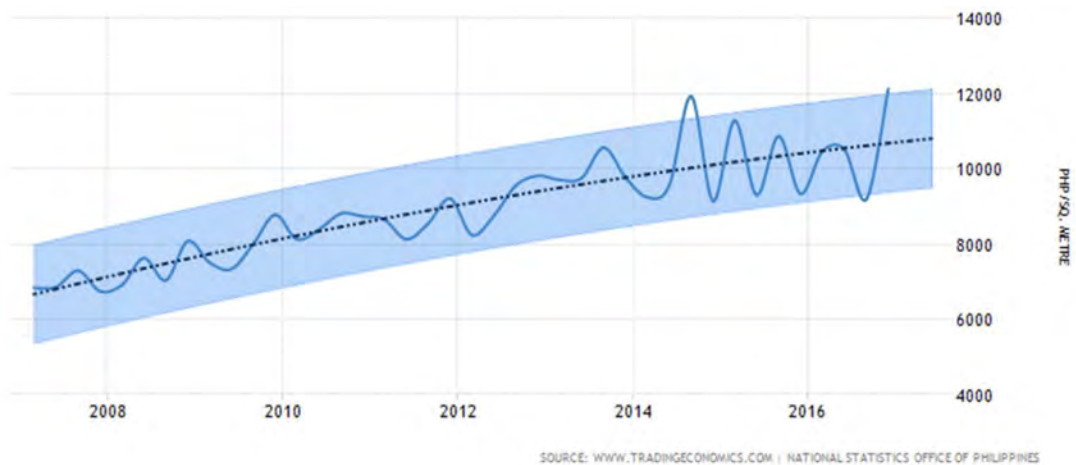


Figure 13: Average Construction Cost (2016, Monthly Frequency)

¹² <http://www.tradingeconomics.com/philippines/housing-index>

In practice, construction costs depend on multiple factors such as the amount of floor area, location, accessibility, regulations and restrictions, topography, building design detailing and specifications, local availability and skillset of labor, material cost, or the source of electricity/water. Because of so many possible individual variances, project related cost calculations require for established building designs and the integration of their local context. Typically, low cost solutions may then be established through comparison of alternative designs and/or specifications.

During design development phases, however, cost predictions and minimizations primarily need for generalization and planning experience. Yet, creating an overview of promising cost efficient design principles may be more useful at such stage. Considering the cost of low to medium rise residential buildings and the current planning stage, low cost for construction can be accomplished by adhering to common design and planning principles such as:

- Simple, orthogonal floor plan layouts that are easy to construct
- Use of common building system and technology that allow for significant cost saving
- Integration and use of advanced technology of when cost saving is realistic
- Minimized ratios of usable space and vertical and horizontal circulation spaces
- Sharing and multipurpose usage of public commodity areas
- Utilization of common construction techniques that can be realized by low skilled labor
- Use of available ordinary finishing's such as simple ceramic tiles or vinyl floorings, ordinary paint, etc.¹³

COMMONLY PRACTICED BUILDING TECHNOLOGY

The use of common building technology and construction techniques are another factor to ensure local labor skills are sufficient for proper realization at low cost. Considering low to mid-rise buildings in the Philippines, two types of buildings structures are used; confined masonry or concrete frames with masonry infill.¹⁴

In a confined masonry building, the masonry walls are built using hollow core concrete bricks, before reinforced columns and beams are poured into it. This helps to make a better connection between the walls and the columns making the building more rigid, and thus more earthquake resistant. Confined masonry requires less qualified labor work and is understood as a low-cost construction technique. However, the technique is also prone to improper workmanship and has its limitations when using it for multi-level buildings.

Reinforced concrete frames are typical column beam constructions that overtake the structural load of the building. Consequently, the columns and beams sizes increase, and are erected prior to the wall. This makes for a weaker connection and requires for sufficient number of tie-ins to maintain the bond between wall and structure.¹⁵ The method is more cost intensive and common buildings with multiple stories where the columns and beams must be much larger and stronger.

Most masonry work used in the Philippines is realized with the use of modular buildings blocks, also known as hollow core concrete blocks. In the following figures x and x, data sheets for a modular building block and a pre-fabricated ceiling plates are shown as possible construction elements.

¹³ http://sibonga.com/philippine_house_pictures.htm

¹⁴ Residential Design and Construction Guidelines, www.buildchange.org

¹⁵ Handbook on Good Building Design and Construction in the Philippines, GTZ Office Manila / UNDP Regional Centre in Bangkok / The Secretariat of the International Strategy for Disaster Reduction



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MODULAR BLOCKS SYSTEM

MODULAR BLOCK SYSTEM is a type of modular construction which uses different kinds of load bearing hollow blocks to build a house without the need for cast-in-place beams and columns. This system reduces the use of forms and concrete and saves time and money. The blocks are manufactured to strict ASTM standards and need partial grouting only on cavities with vertical reinforcement. The blocks have smooth surface and will only need tool joint finish. All these features will give you savings on plastering cost.

FEATURES & BENEFITS :

- Highly recommended for the single-detached houses, duplex and townhouse of up to 2 storeys.
- Masonry works can be done in just 7 days for a 30 sq.m. one-storey single-detached house.
- Saves on wooden forms and requires less concrete on site as cast-in-place beams & columns are done away with.
- Requires partial grouting only on core holes with vertical reinforcement.
- With smooth surface finish, no plastering needed, requires tool-jointing only.
- Highly compacted with low water absorption rate.



STRETCHER BLOCK
The hollow blocks that is familiar to all. Generally, it is used in wall partitions, fences, retaining walls and most other applications. Its cores allow more than ample space for reinforcing bars, electrical and plumbing conduits. It is ideal for high rise buildings that require load bearing walls.
Available Strength : 700 & 1000psi



L-CORNER BLOCK
The L-Corner Block is unique to the 140mm series. Its main function is to provide an interlock in the corners. This naturally makes the wall to wall joint sturdier.
Available Strength : 1000psi



BEAM BLOCK
The Beam Block is a reinforcing unit used with other beam blocks to strengthen walls. It is needed in structures that are open to strong winds and vulnerable to earthquake, the beam block also serves as a lintel beam on top of doors, windows and similar wall openings.
Available Strength : 1000psi



SEALED-END BLOCK
Similar to Stretcher Block but it is designed primarily for partial grouting. Notice the end base is intentionally sealed.
Available Strength : 700 & 1000psi



HALF BLOCK
Designed primarily to eliminate the nuisance and inconvenience of cutting blocks in half. It is used in ending walls, doors and windows.
Available Strength : 700 & 1000psi



LIGHTWEIGHT BLOCK
Lighter than non-load CHB than 45% which reduces foundation cost. Provides aesthetic in architectural finish for walls and partitions.
Available Strength : 500 & 700psi



PAVING BLOCK
An alternative to conventional paving and concreting. It is designed for easy installation & maintenance of pavements of various designs and patterns. Ideal for patios, garages, driveway & walkways
Available Strength : 6000psi
Available sizes : 100 x 200 x 120mm

STRONGER • FASTER • BETTER

Figure 14: Product Data Sheet Modular Block System

¹⁶ JackBilt Industries (<http://www.jackbilt.com.ph/>)



JACKBILT
INDUSTRIES
ESTABLISHED 1948



RIPPED SLAB SYSTEM

RIPPED SLAB SYSTEM is a system consisting of precast prestressed half slabs with concrete upstands (rib) that are purposely designed to provide the necessary stiffness to the slab for handling, act as spacers for mesh reinforcement, and to provide a positive tie between the precast element and in-situ concrete topping to ensure a composite action between both. It's smooth soffit or slab bottom eliminates the need for drop ceiling and is ready for painting.



RIPPED SLAB CROSS SECTION

TECHNICAL DATA :

A. CONCRETE PROPERTIES

- Concrete Density, 2,400kgs/m³
- Strength @ 28 days, f'c = 41.4 MPa (6,000 psi)
- Strength @ release, f'ci = 27.6 MPa (4,000 psi)
- Modulus of Elasticity @ service, Ec=30,094 MPa

C. PRESTRESSING STEEL

- 7-wire, high tensile, helical strand
- Ultimate Strength, fpu = 1,860 Mpa
- Yield Strength, fpy = 1,630 Mpa
- Modulus of Elasticity, Ep = 195, 000 Mpa
- Nominal Diameter, D = 9.53 mm
- Area of Wire, Ap = 55 mm²

B. CROSS SECTIONAL PROPERTIES

- Width = 1,196 mm
- Height of plank = 60 mm
- Height of rib = 70 mm
- Cross Sectional Net Area = 88,261mm²
- Top fiber to Neutral Axis (Ytop) = 87.0 mm
- Bottom fiber to Neutral Axis (Ybot) = 43.0 mm
- Moment of Inertia (Ix) = 90,486,200mm⁴
- Self weight = 212 kg/m
- Self weight including concrete levelling topping = 312 kg/m²

D. CONCRETE TOPPING

- Provide concrete with a minimum strength @ 28 days, f'c = 20.7 Mpa (3,000psi) at space between ribs to produce flat surface and a solid slab section.
- To increase the capacity of ribbed slab, provide additional structural topping with a min. strength @ 28 days, f'c=20.7 MPa (3,000psi)
- From top of rib = 30mm height.
- 6mm diameter @ 150mm O.C. wire mesh reinforcement

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Figure 15: Product Data Sheet Ripped Slab System

¹⁷ JackBilt Industries (<http://www.jackbilt.com.ph/>)

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ALTERNATIVE SCHEMATIC DESIGNS

With the conclusion on possible environmental and economic design measures for design improvement, two schematic designs were developed and presented. The schemes are briefly described and illustrated in the following.

SCHEME A

Scheme A is designed to accommodate up to 288 (12x6x4) units sized 33 sqm, and 272 (17x4x4) units sized 24 sqm. For each apartment type, separate buildings have been foreseen. Altogether, six buildings are allocated for the government employees to the North of the property, and the four buildings for the informal dwellers to the South of the property. Between the two building types a green area for multi-purpose use that is accessible from both sides, as well as the service building for the vacuum sewage pumps is allocated.

The buildings are accessible by one main road along the West side of the land, connecting the North and South entrances of the property. Along the road, parking spaces for cars and motor cycles, as well as garbage collection areas are provided.

To optimize the access to the buildings, the design foresees to link two adjacent building units to one main stair case. This way the overall number of stairs can be reduced. All stairs lead from the 1st to the 4th floor level without connecting to the roof of the buildings. Roof access is foreseen separately via openings in the ceilings and the use of mobile ladders whenever necessary. This way misuse of the roof areas as well as cost saving can be achieved. The roof surfaces are constructed as flat concrete slabs to maintain the chosen construction technique on the floor slabs below, as well as protect against extreme weather conditions. A protective coating against coating and solar radiation.

On the roof levels, necessary fresh water tanks are to be installed in specifically foreseen enclosures.

First floor levels of the buildings are raised 1,5 m above the ground floor level to avoid possible flooding through severe weather conditions, improving for better natural ventilation of the first floor level as well as improving the visual quality between the floor level and its surroundings.

In the buildings, the residential units are connected sideways in a linear manner. A corridor is enabling for access with units along both sides. Every two units share one vertical shaft for plumbing installations and eventual water meters. Further, the corridors are not entirely enclosed, with openings to the outside whenever possible to support natural ventilation. In case that security becomes an issue, access through larger openings can be prevented using ventilation blocks.

The design of the residential units further foresees the possibility of allowing for natural ventilation. As for the 33 sqm units for city employees, window openings are generally provided along the exterior walls of the East and West facades and to the corridors of the building. This way a natural ventilation through the residential units can be generally realized. In addition, the residential units are designed as pairs leaving a gap between them for corridor access from the main stair and escape stairs and voids for naturally ventilation. When possible, window openings are allocated to these areas as well to further improving ventilation possibilities of the units.

To protect against solar radiation, horizontal shades are allocated above each floor level as a cantilevered extension to the floor slabs above. To further reduce buildings costs and make individual units more attractive, the units are anticipated as semi-finished, allowing occupants to improve their own gradually and according to their individual budgets available. Thus, installation such as suspended ceilings or flooring (except for the wet areas) may not be provided for.

SITE LAYOUT



Figure 16: Scheme A - Masterplan



Figure 17: Scheme A – Vizualiation Site View

	Type	Area [m2]	Percentage
	Property Size	22147.00	
	Gross Floor Area (All Floors)	42130.61	100.0%
	Floor Area (1st Floor)	6292.60	14.9%
	Buildings Government Employees	14876.86	35.3%
	Buildings Informal Settlers	10293.53	24.4%
	Green + Parking	12015.07	28.5%
	Road	4065.15	9.6%
	Sewer	880.00	2.1%

Figure 18: Scheme A - Overview Land Use

BUILDING LAYOUT

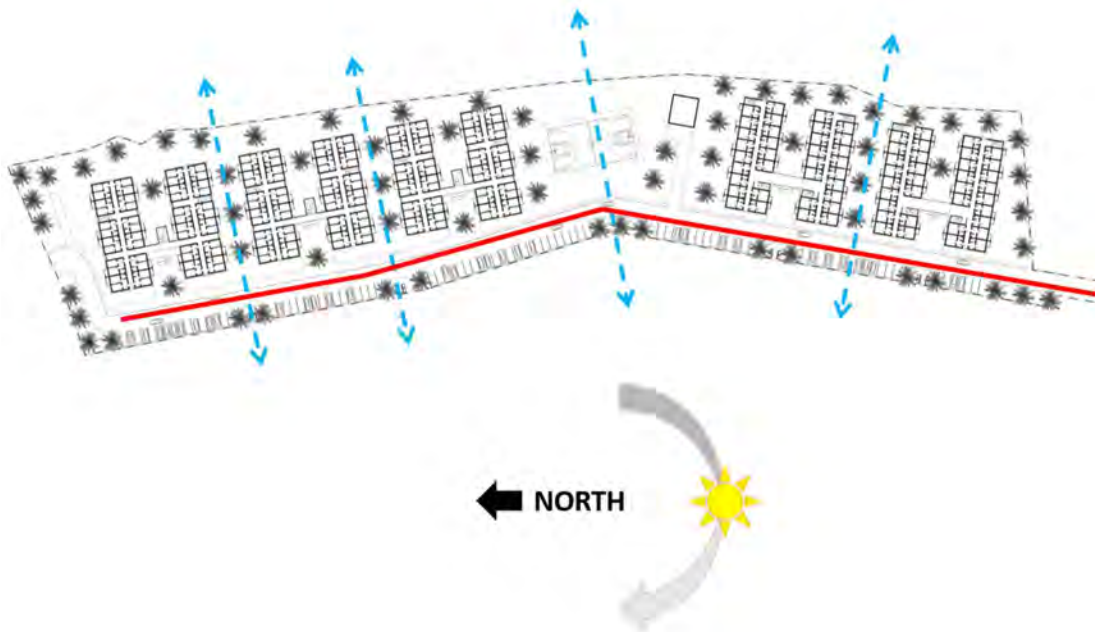


Figure 19: Scheme A - Building layout and orientation

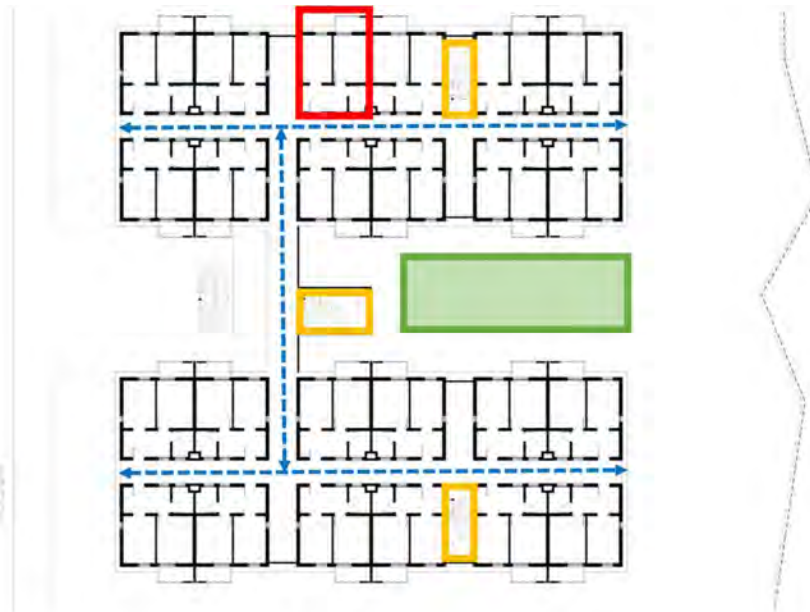


Figure 20: Scheme A - Floor Plan Layout for building of Government Employees

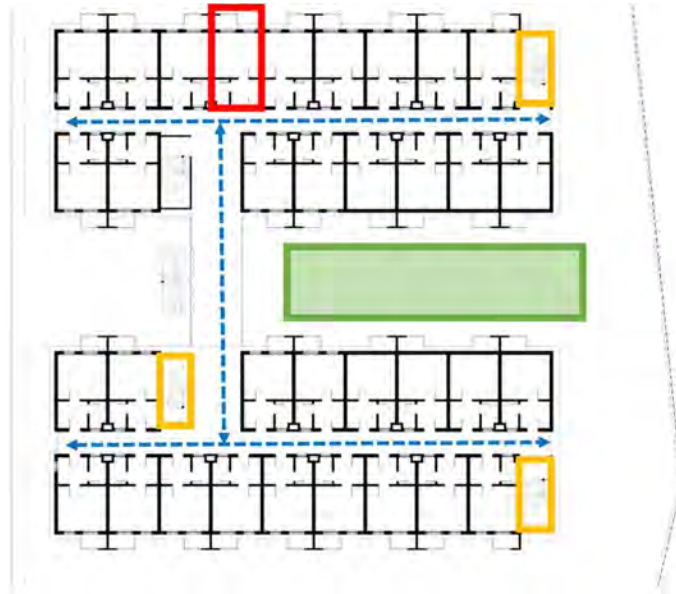


Figure 21: Scheme A - Floor Plan Layout for building of Informal Settlers

UNIT DESIGN

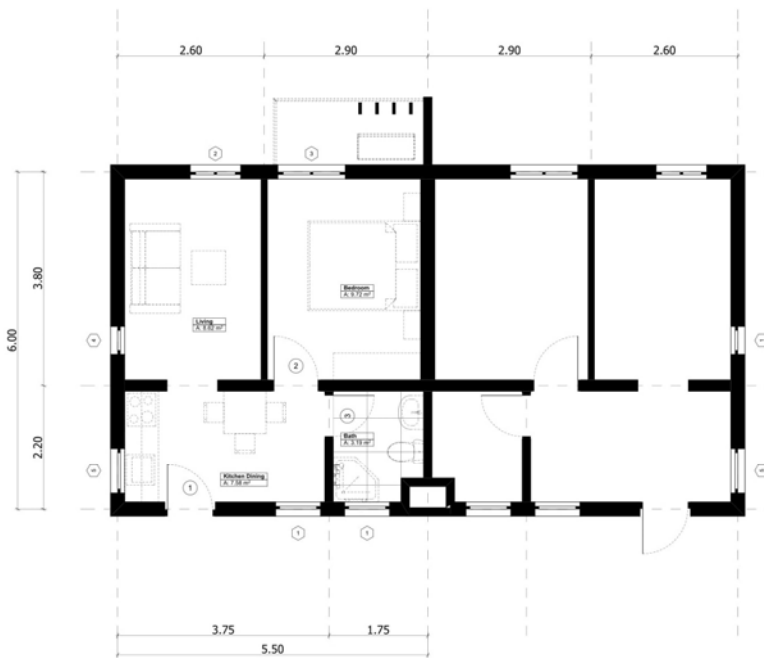


Figure 22: Scheme A - Floor Plan Layout of Apartment for Government Employees [33 sqm]

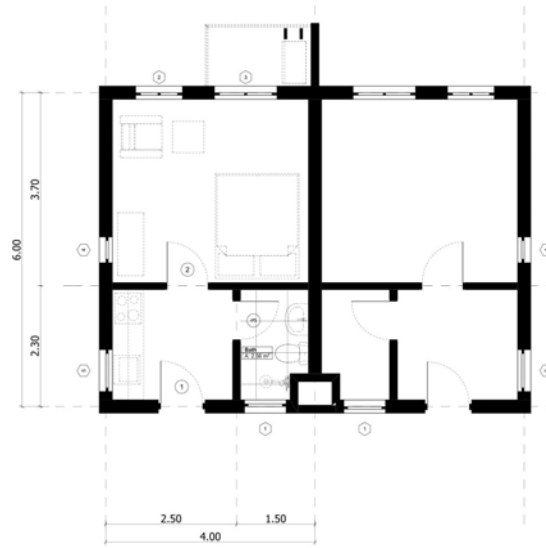


Figure 23: Scheme A - Floor Plan Layout of apartments for Informal Settlers [24 sqm]

SCHEME B

Scheme B is designed to accommodate up to 248 ((16x3x4) + (14x4)) units sized 33 sqm, and 216 (16x3x4) units sized 24 sqm. Like Scheme A, for each apartment type, separate buildings have been foreseen with four buildings allocated for the government employees to the North of the property, and three buildings for the informal dwellers to the South of the property. Also, similar, the overall design foresees the arrangement of buildings in East/West orientation and the building access via one main access road, providing parking spaces for cars and motorbikes and combining garbage collection areas of the building units. Between the buildings are green zones with trees to help shading the elongated facades. Further, in-between the two building types is a green area for multi-purpose use that is accessible from both sides. The building for the vacuum sewage pumps is allocated near to the property access to the South.

Different to the earlier scheme is the direction of the road, which is shifting from the West to the East boundary when half way through the property. This modification aims to separate the land into two housing zones, one for city employees and one for the informal dwellers, more distinctively.

As illustrated in the following figures the overall building layout and orientation of scheme B follows the general understanding described in scheme A, where building types with East/West orientation achieve a better protection against exposure of solar radiation. To allow for more privacy between the buildings, green zone with trees are helping to separate and further protection the facade units with the shading. Multipurpose outdoor areas remain in the center, between the two building types, where the access road is shift from the West to the East side.

All buildings remain separate and do not share vertical access points. Both building types include an interior courtyard to improve natural ventilation and natural lighting conditions the apartment units. The courtyards establish a friendlier surrounding within the building units, providing semi outdoor spaces with higher remain quality. As shown in figure x, the building type for the 33 sqm apartment units is organized via two linear arrays in East West orientation. Natural ventilation is encouraged via cross ventilation in North South direction and stack ventilation via the interior courtyard.

The design for the 24 sqm units building type follows the idea of the 33 sqm unit building type.

A maximum lineup of 9 units can be achieved with a total of 18 units per floor, or, considering four levels of the building, altogether 72 units per building type. Like the 33 sqm apartments, the 24 sqm units are designed to provide openings towards their North and South orientations that ensure their cross-ventilation capability. Additionally, the inner courtyard of the units permit for stack ventilation and the removal of hot air within the corridor areas of the building

On a more social level of understanding the inner courtyard can allow for positive interaction among the residents as it is likely to create a friendlier atmosphere when compared to the stringently organized two sided corridors of common building designs. While probably more user friendly, one disadvantage is the higher amount of corridor space, likely leading to slightly higher construction cost.

The design for the individual apartment units vary only slightly to the first scheme.

Here the bathroom of the 33 sqm units move towards the exterior façade, allowing for their improved natural ventilation and the possibility to connect all fresh and waste water piping's to one vertical installation shaft. A disadvantage in this proposal is likely the reduced flexibility in reorganizing living or sleeping spaces for individual use. Because the 24 sqm unit is already optimized to increase the usable space no further alternative design solution has been made. No alternative design is provided in Scheme B.

SITE LAYOUT

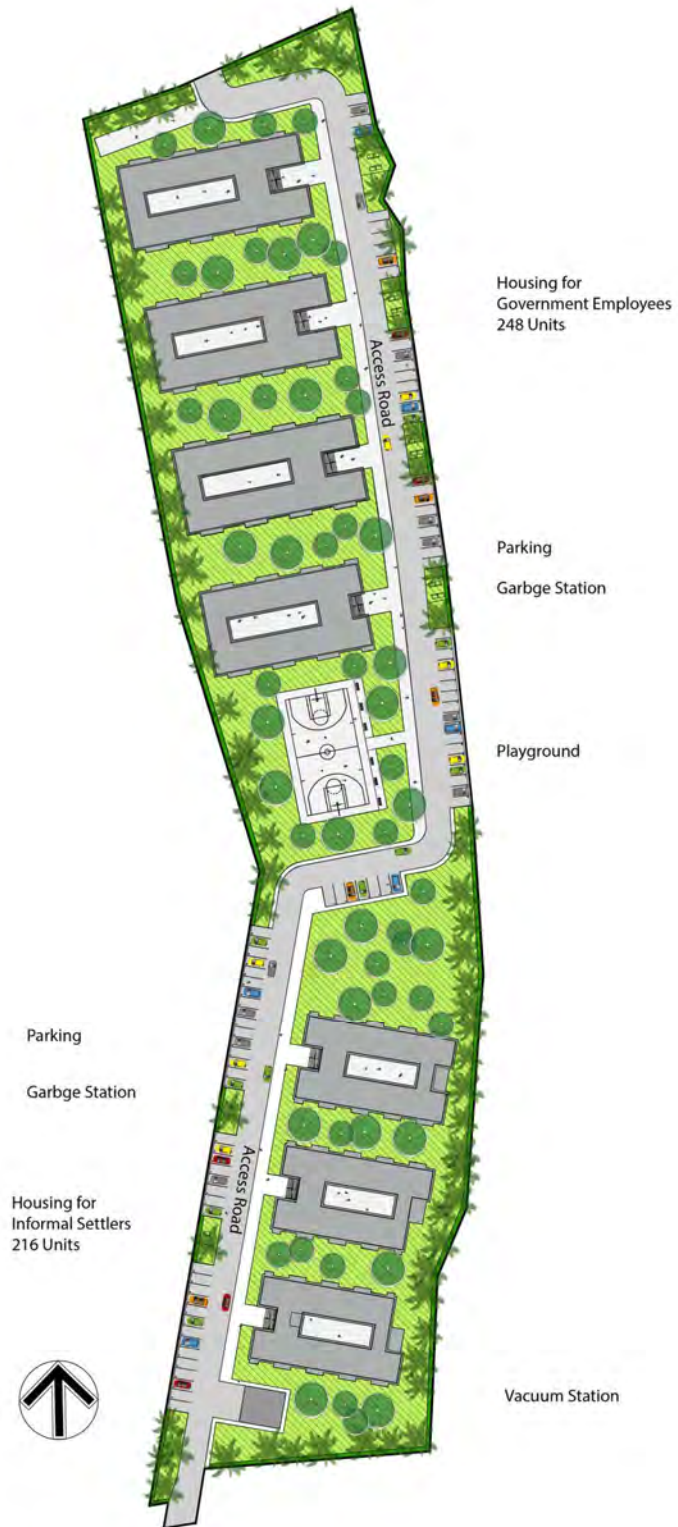


Figure 24: Scheme B - Masterplan



Figure 25: Scheme B – Visualisation Site View

Type	Area	Percentage
Property Size	22147.00	
Gross Floor Area (All Floors)	40969.32	100.0%
Floor Area (1st Floor)	6006.29	14.7%
Buildings Government Employees	14761.93	36.0%
Buildings Informal Settlers	9263.21	22.6%
Green + Parking	11500.90	28.1%
Road	4563.27	11.1%
Sewer	880.00	2.1%

Figure 26: Scheme B - Overview Suggested Land Use

BUILDING LAYOUT

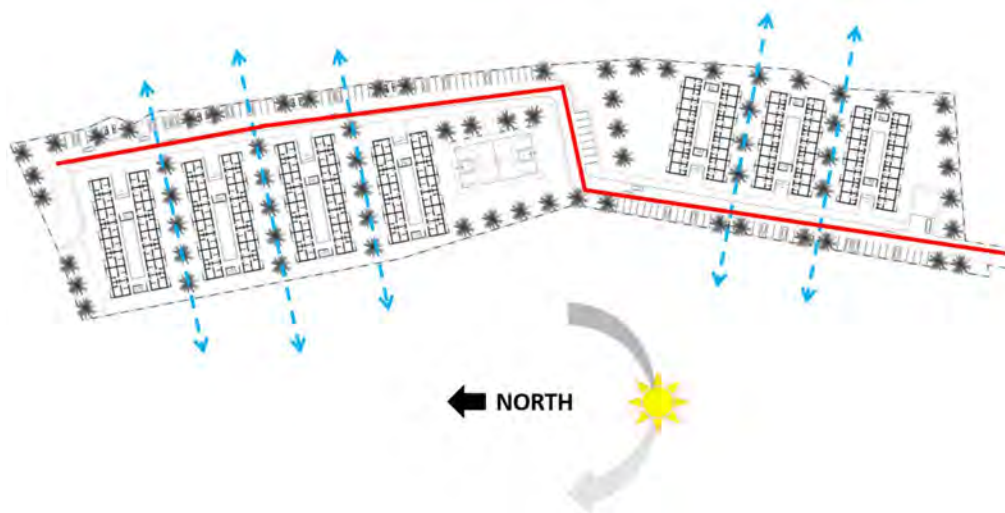


Figure 27: Scheme B - Building layout and orientation

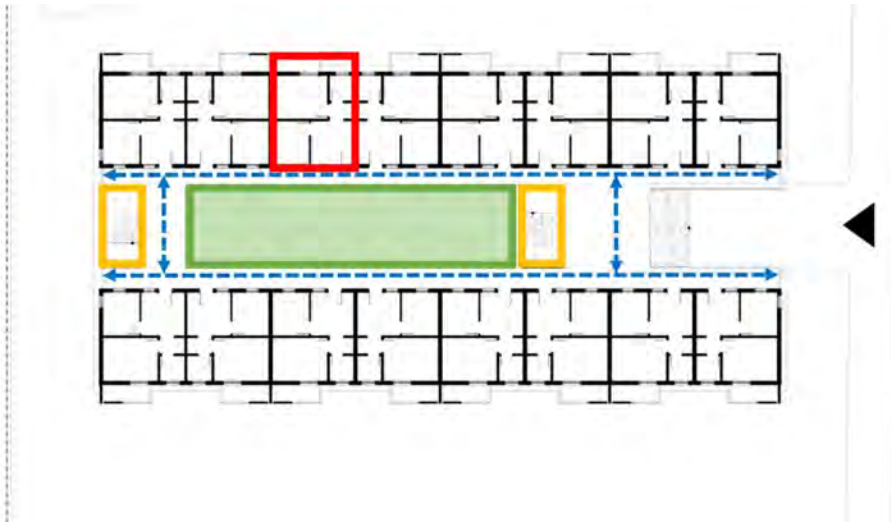


Figure 28: Scheme B - Floor Plan Layout for building of Government Employees

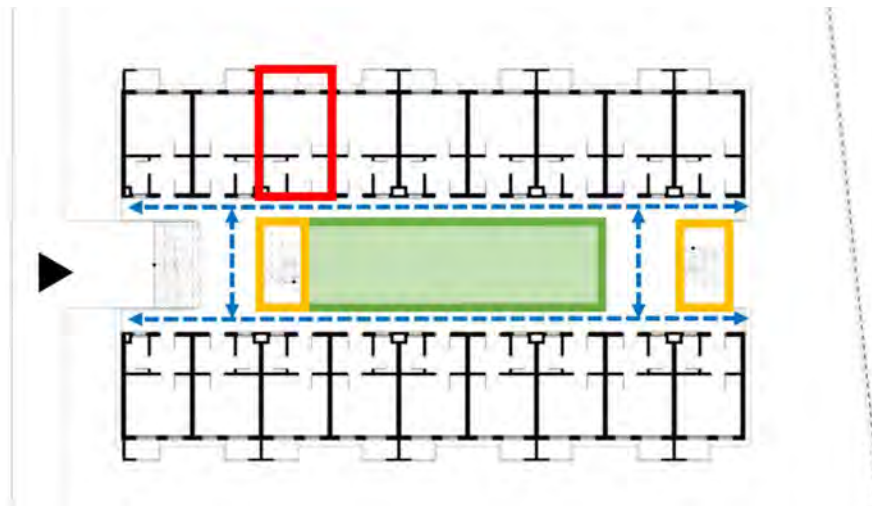


Figure 29: Scheme B - Floor Plan Layout for building of Informal Settlers

UNIT DESIGN

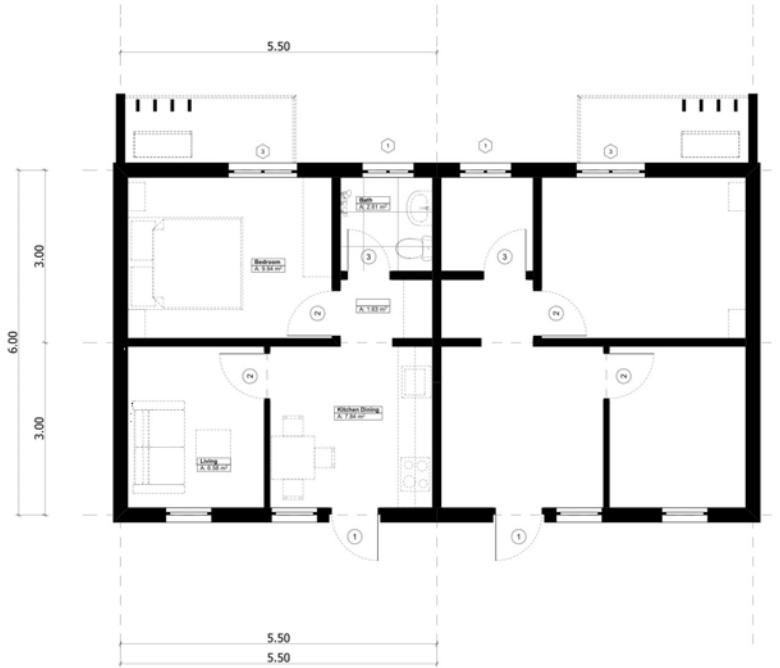


Figure 30: Scheme B - Floor Plan Layout of Apartment for Government Employees [33 sqm]

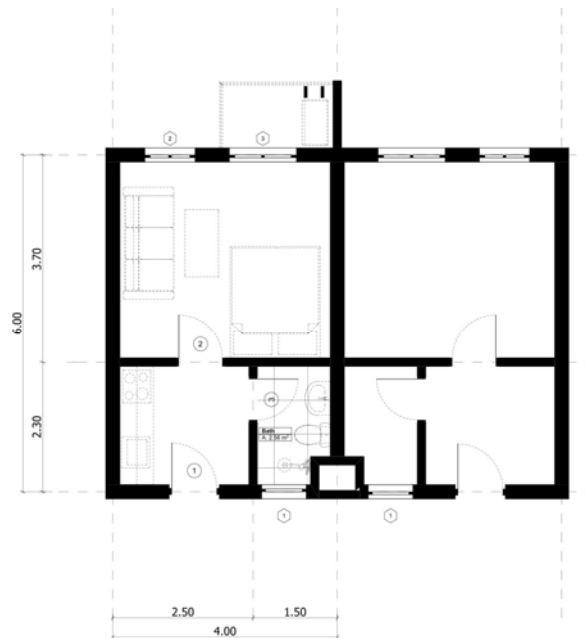


Figure 31: Scheme B - Floor Plan Layout of apartments for Informal Settlers [24 sqm]

FINALIZATION OF ARCHITECTURAL DESIGN

With the feedback on the presented design schemes, a final design was generated based on the selection of the Nexus Planning team. The design was developed and documented. The response to the suggestions are briefly described and the architectural drawings are illustrated in the following.

SUGGESTIONS AND COMMENTS

As a response to the presented design schemes the planning authority of the City of Santa Rosa and the local Nexus team suggested choosing 'Scheme A', as it offered to be more economical in terms of apartment unit amount and minimized volume of the building units. In addition to the highlighted sustainable and cost-efficient features of the design, several suggestions were made to be incorporated into the design scheme. In the following the suggestions, combined with a comment regarding their design integration are briefly described:

- A. *It was suggested that the building floors should be increased from 4 to 5-storeys to maximize the land use accommodating more people.*

While it is generally possible to add more floor levels to the building units to the existing design, there are concerns regarding the cost efficiency of the building construction, as well as the amount of densification level reached. Typically, increasing the amount of floor levels would raise the question whether elevators needed to be included, which are known to significantly increase construction costs. With international building regulations suggesting elevators for levels above the fourth-floor level for multi-residential buildings. Existing building code requirements may, however, still differ and accept such.

The structural integrity of using a confined masonry construction technique may also be compromised when adding floor levels. Such may not only require for already costlier structurally detached column beam construction, but also increased masonry ty-ins considering necessary earthquake precautions.

Concerning the overall population density on site, assuming an average 3-person household per unit, the suggested buildings design with four levels would amount to a total of 1,680 residents, and 2,100 residents when considering five floor levels.

Considering the earlier mentioned population density of Santa Rosa with 5,033 people per square kilometer (p/sqkm), the calculated population density on site is significantly higher with 75,855 p/sqkm, and 94,821 p/sqkm respectively. With the design proposal being a high-density area already, it is suggested to not further increase the amount of floor levels, but to keep the existing relation of green area and the number of inhabitants to avoid possible social conflicts.

- B. *The elevation from the ground will be retained, however, the finished grade line to finished floor line of 1m in height based on the proposal will be decreased to 0.50m thru embankment.*

In the proposed design scheme, the floor level was raised 1.5 m from the surrounding ground level to prevent possible flooding hazards to the apartment units and avert possible break ins into the first-floor levels units. As suggested, a minim height level of 1.0 m above the surrounding ground floor level is realized in the final design. It should be noted that further reducing the height difference further will make the exit of the escape stairs become obsolete. The planned embankment will also need to be lowered in that area to allow exit.

- C. *A provision for an administrative and homeowners' association office has been advised.*

In the revised design, an office space is provided for as replacement of one 33 sqm apartment unit. It is shown in the first- floor plan layout of the final design of the building type for government employees.

- D. A space for a trench-type detention pond should be implemented into the masterplan design to ensure flooding damages will be minimized and comply with the provisions of the LGU's land developer's guidebook.*

A detention pond is foreseen behind the multi-purpose areas in the center of the property. Trenches leading to detention pond can also be realized along the property boundary to the East.

- E. It is recommended that the buildings and units have no ceilings adopting 'industrial design' wherein the pipes are exposed.*

The final design does not provide suspended ceilings within the building to ensure cost efficiency. Windows and openings are within sufficient distance to ceilings to allow owners installing suspended ceilings individually if desired.

- F. All cables and wires are embedded*

The suggestion has been noted and agreed to, however, in the current stage drawing documentation stage it may not be recognizable. Embedded installation and wiring may also depend on the finally decided construction technique and structural dimensioning of the engineers.

- G. 30% of the total area should be devoted as 'open space' per the Philippine guidelines of the Housing and Land Use Regulatory Board*

In the respect to the current design the total area of open space is calculated as:

The following figure shows the overall area distribution on the property:

Type	Area	Percentage
Property Size	22,147.00	
Gross Floor Area (All Floors)	22,592.91	100.0%
Floor Area (1st Floor)	5,822.82	14.7%
Buildings Government Employees	...	36.0%
Buildings Informal Settlers	...	22.6%
Streetscape	4,830.11	28.1%
Landscape	11,494.07	11.1%
Sewer	880.00	2.1%

Figure 32: Final Design - Overview Suggested Land Use

- H. Separate outdoor multi-purpose areas for the government employees and informal families should be provided.*

In the final Masterplan, two outdoor multi-purpose areas are allocated in center of the land plot, between the two building areas for government employees and informal settlers. They are visual separated by the access and technical building for the vacuum pumps.

- I. *Develop 2 or 3 designs which the homeowners can choose from which they can adopt taking into consideration the proposed design and lay-out, i.e., laundry area, storage, bedroom/s. The units will be turned-over as 'bare' and improvements will be an added cost to the buyer.*

Design variation for apartments, as suggested, do not exist. The units are still foreseen to be sold as 'bare'. Yet, to ensure cost efficiency the units have been designed in a way that later changes by homeowners can be realized without interfering existing building installations. Currently, the apartment designs are divided into two zones: a smaller Zone A allocated along the corridors wall and combining entrance area, kitchen, and bathroom areas, and a larger Zone B for living/sleeping purposes. It is foreseen that technical installations such as plumbing remain in close distance to the vertical installation shafts and thus remain within the Zone A. Accordingly, a water and power connection for a laundry machine is foreseen in the pantry area.

Later modifications by home owners can be realized in the Zone B to the extent that the area is subdivided to fit individual needs for separate rooms or storage. In the current design of the 33 sqm apartment, the separating wall between the bedroom and living room is anticipated of not being load bearing, can thus be relocated as a drywall system, or removed according to the owners wishes. Considering the 24 sqm apartment unit, design modifications are generally difficult due to the small size of the unit, but can be realized for the living/sleeping area nonetheless.

- J. *It is also suggested to add 2 units per level for the first three buildings on the left (City government employees building), for a total of 30 units, to even out the distribution of area and space.*

The current building dimensions prevent further building expansion when considering necessary setback from the property lines. Adding more units to the existing building volume would thus compromise the natural ventilation concept for the apartment units. In respect to the comments regarding the already increased population density, the final design does not increase the units amount per level.

FINAL SCHEME DRAWINGS
SITE LAYOUT

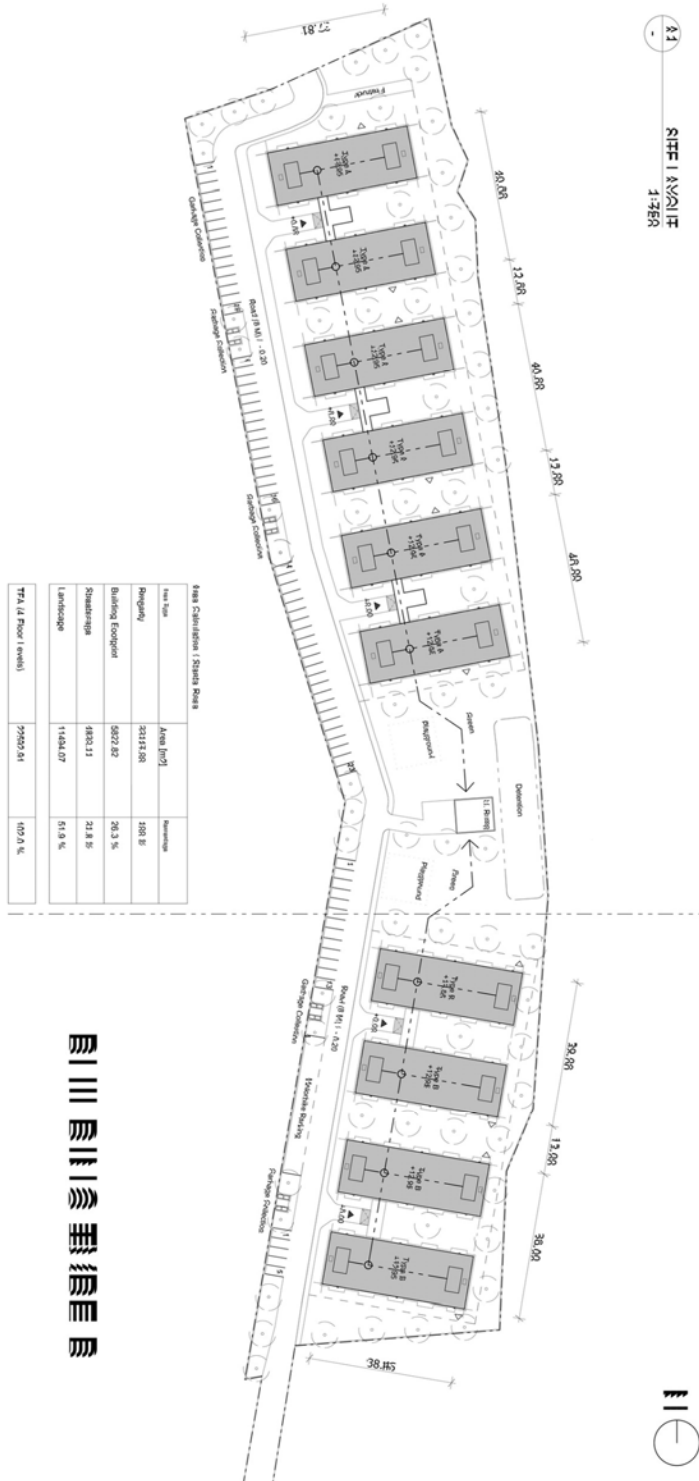


Figure 33 Final Design - Masterplan

BUILDING LAYOUT

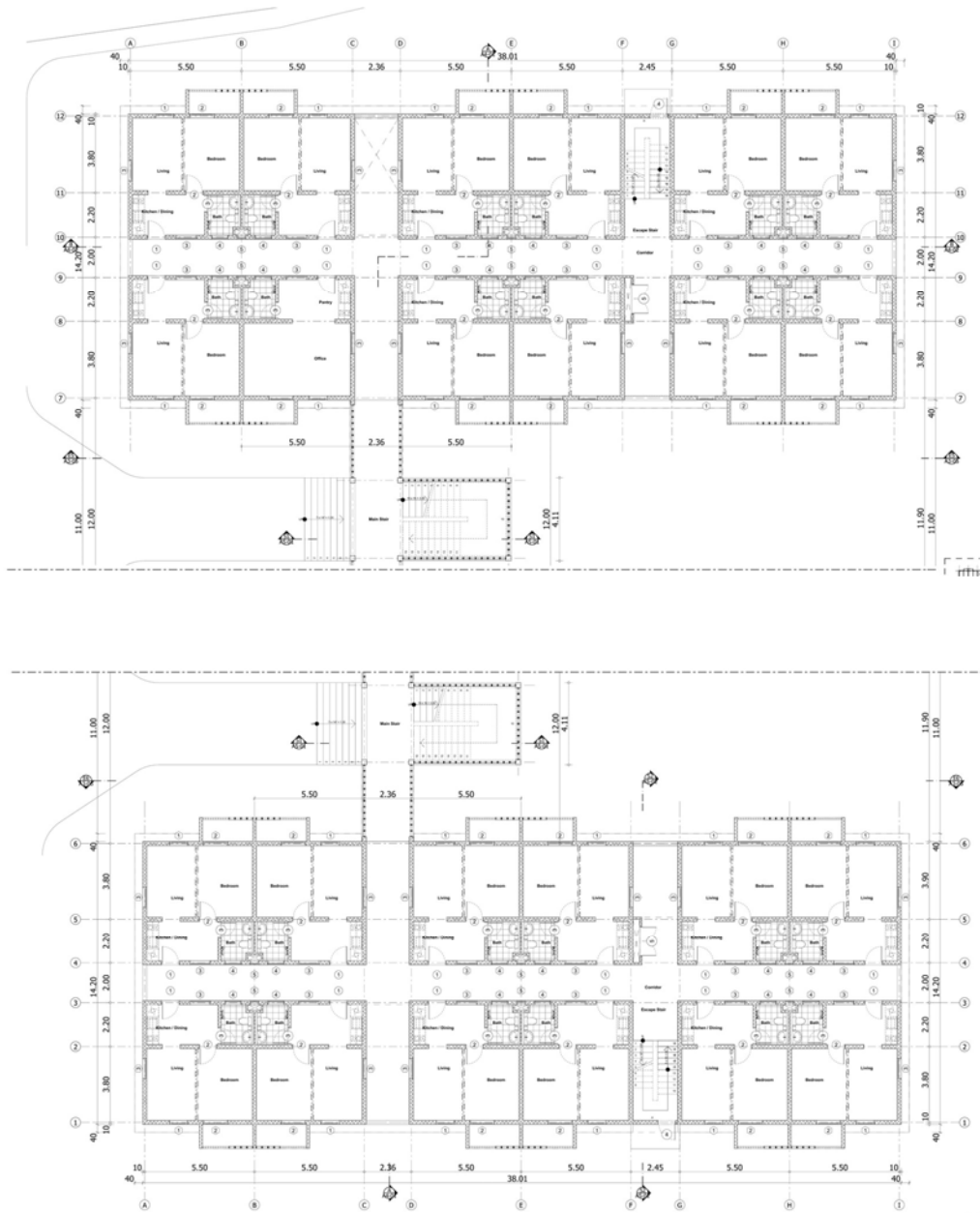


Figure 34: Final Design - Building Type A for Government Employees - Floor Plan Layout First Floor

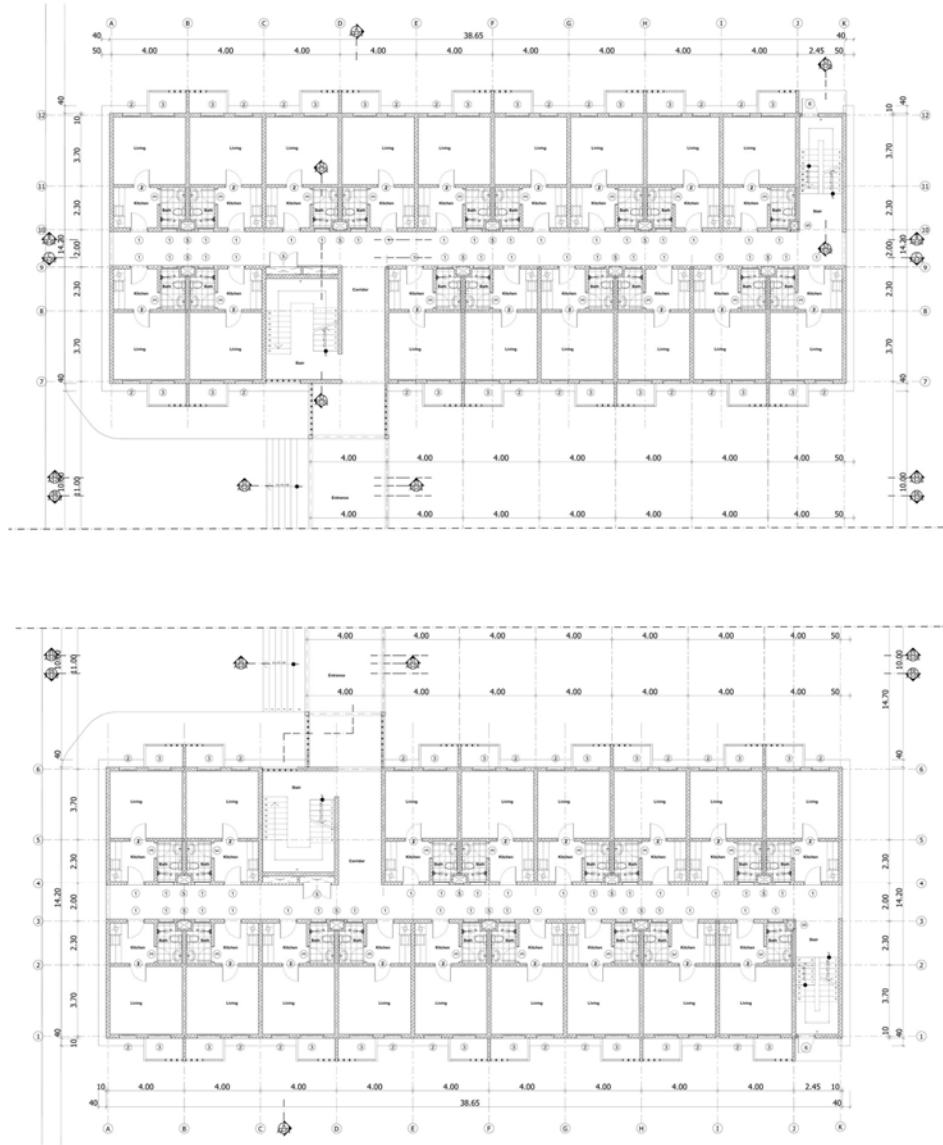


Figure 35: Final Design - Building Type B for Informal Settler - Floor Plan Layout First Floor

UNIT DESIGN

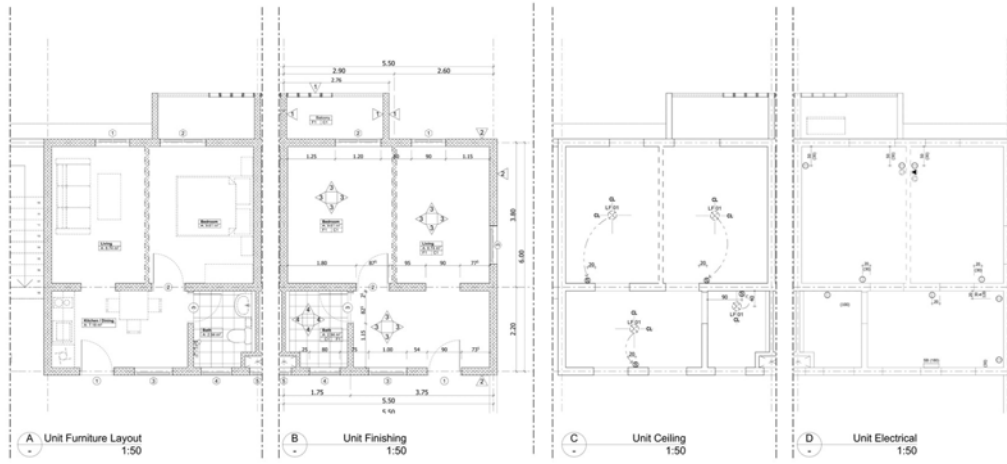


Figure 36: Final Design - Building Type A for Government Employees – Apartment Unit - Floor Plan Layout

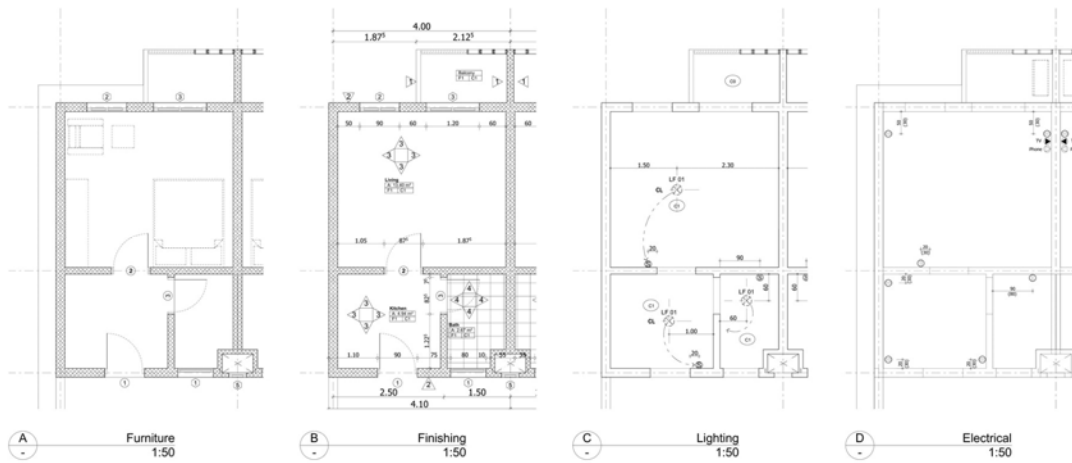


Figure 37: Final Design - Building Type B for Informal Settler – Apartment Unit - Floor Plan Layout

SUMMARY AND RECOMMENDATION

RESULTS SUMMARY

Several improvements regarding environmental and economic considerations have been proposed and included in the design. Considering the analysis existing preliminary design the following measurements were integrated:

ENVIRONMENTAL MEASURES

- ✓ Possible natural cross ventilation integration of building and individual apartment units
- ✓ Improved building orientation
- ✓ Improved flooding protection
- ✓ Improved shading of building envelope via extended horizontal shading slaps per floor level
- ✓ Improved shading of building envelope via plantation alongside the elongated façades
- ✓ Improved daylighting through increased vertical window openings with upper transoms
- ✓ Limitation of number of residents per building for the benefit of social balance
- ✓ Integration of geographical hazard considerations (earthquake, flooding)

ECONOMIC MEASURES

- ✓ Simple design based on conventional construction approach (Confined Masonry)
- ✓ Integration and consolidation of repetitive design elements
- ✓ Optimized ratio of areas for units to corridor infrastructure
- ✓ Design of rectangular rooms and shapes
- ✓ Design with continuous and coherent load distribution
- ✓ Design consideration of using ordinary construction materials
- ✓ Design of apartment units anticipating semi-finished condition

RECOMMENDATION

With the presented architectural design concluded, it is recommended to remain with the currently proposed amount of apartment units, as an increase of units may not lead to the anticipated cost reduction. It may also lead to increased population density with negative side effects such as social conflict, misuse, and neglect of property.

In case the Nexus Planning team and the planning team of the City of Santa Rosa wants to pursue the realization of the building design as planned, the current architectural design needs for design verification of compliance with existing building regulation codes, a structural engineering calculation and specifications, as well as MEP planning and specifications before obtaining the building approval from the local building authorities and the construction drawing planning and documentation.

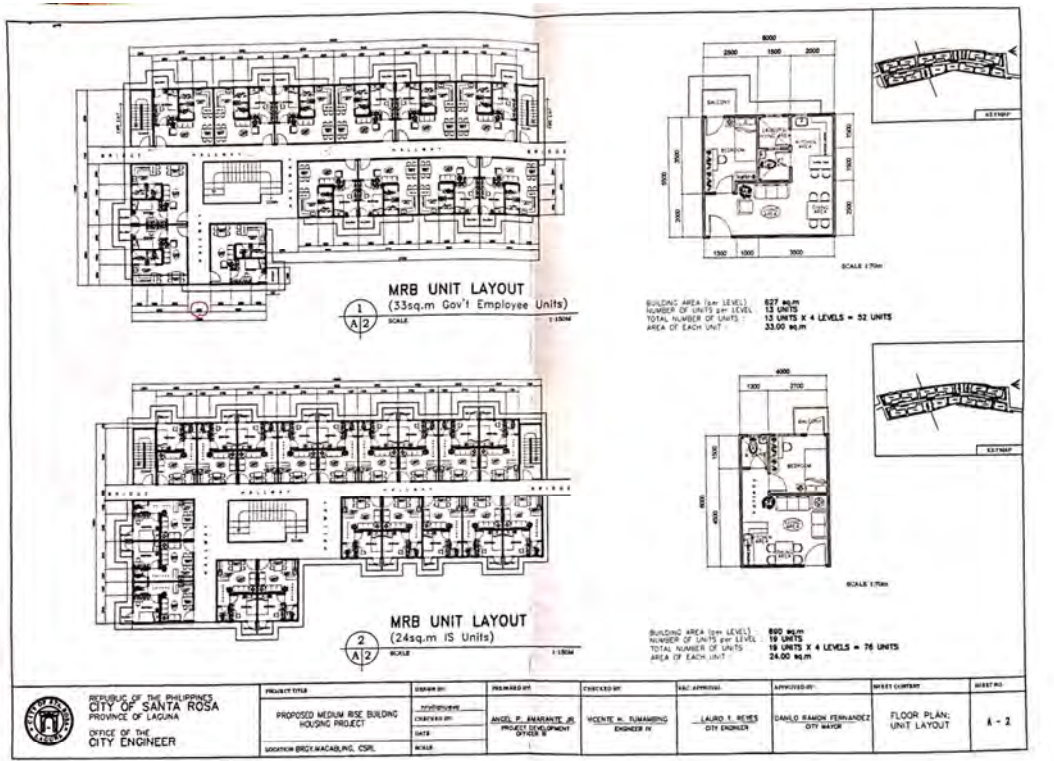
April, 2017

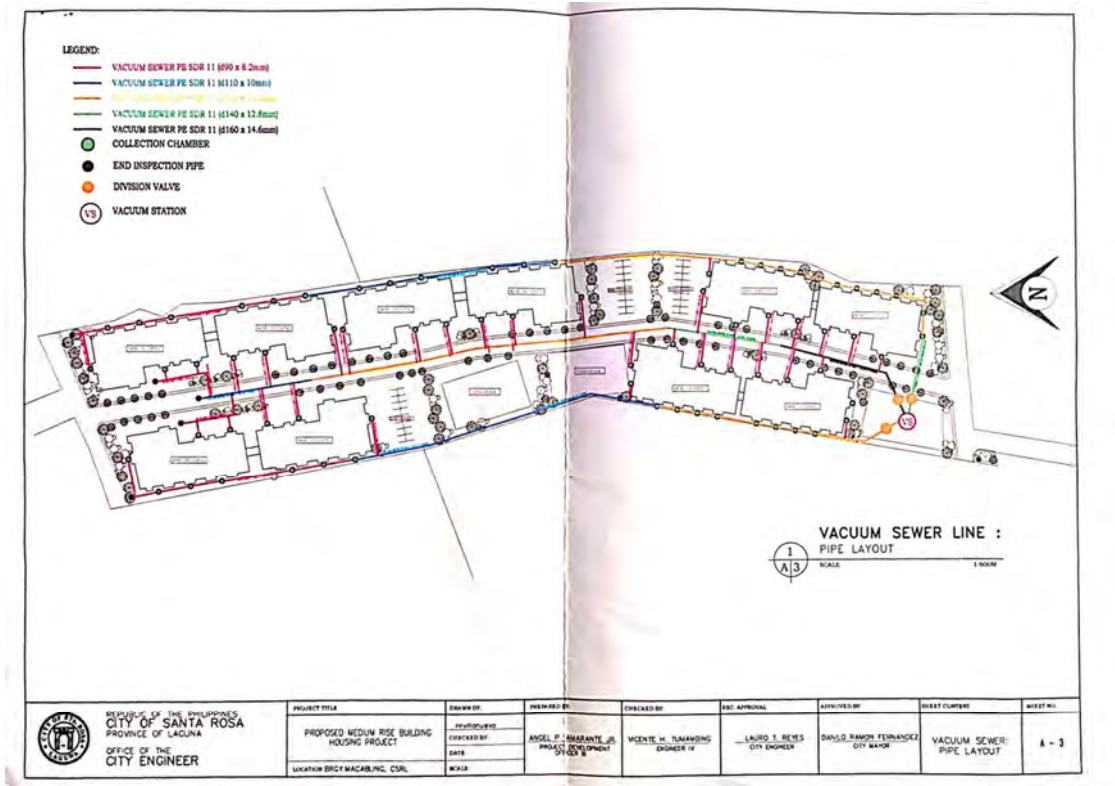


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APPENDIX

DRAWING DOCUMENTS PRE-DESIGN





FINAL DESIGN COMPLETE DRAWING DOCUMENTATION
 BUILDING TYPE A – HOUSING FOR GOVERNMENT EMPLOYEE

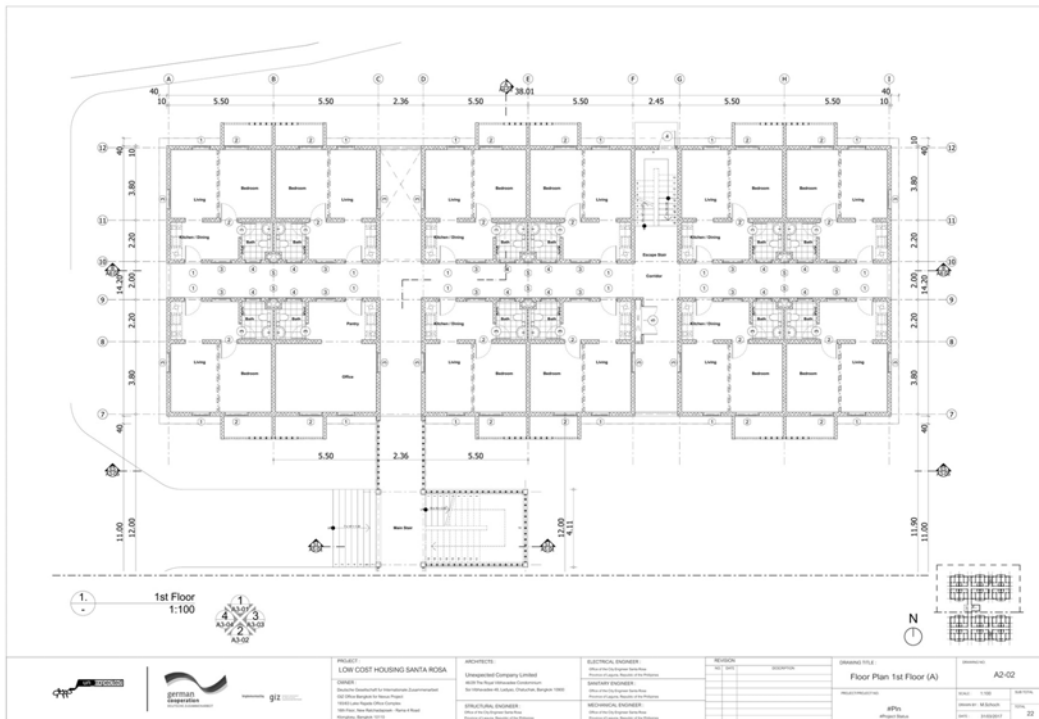
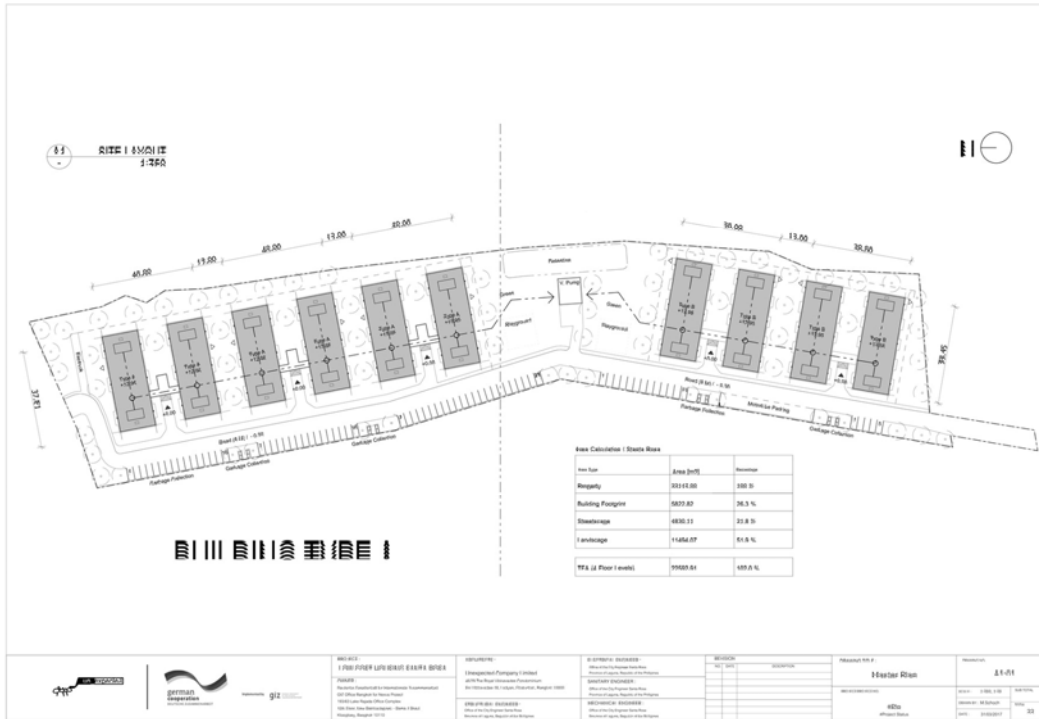


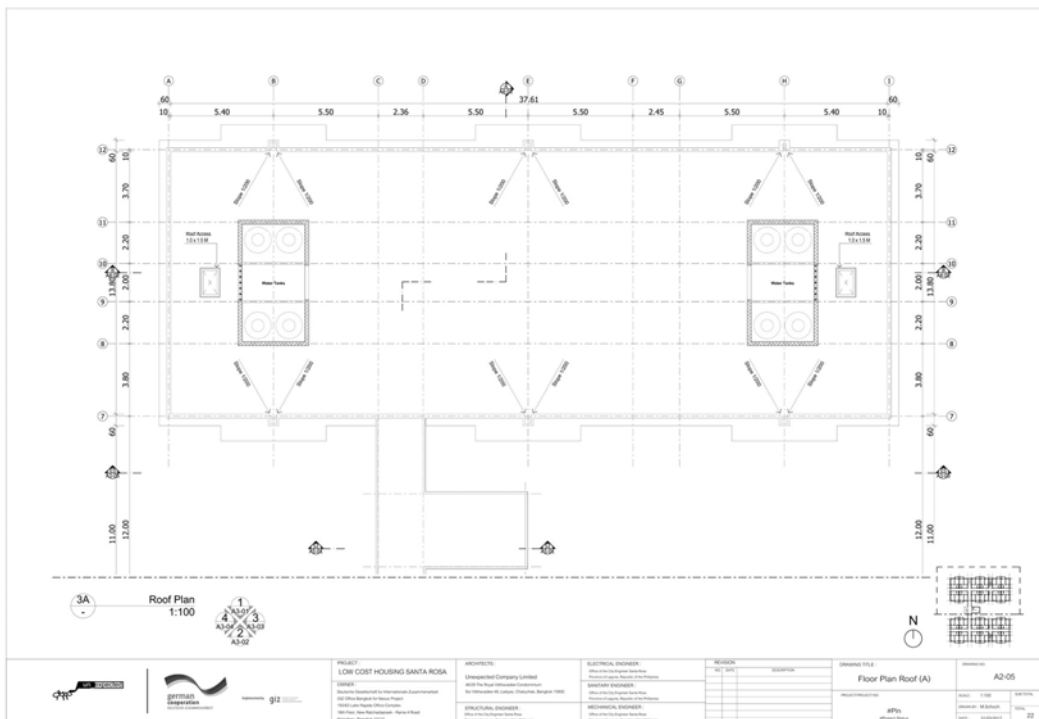
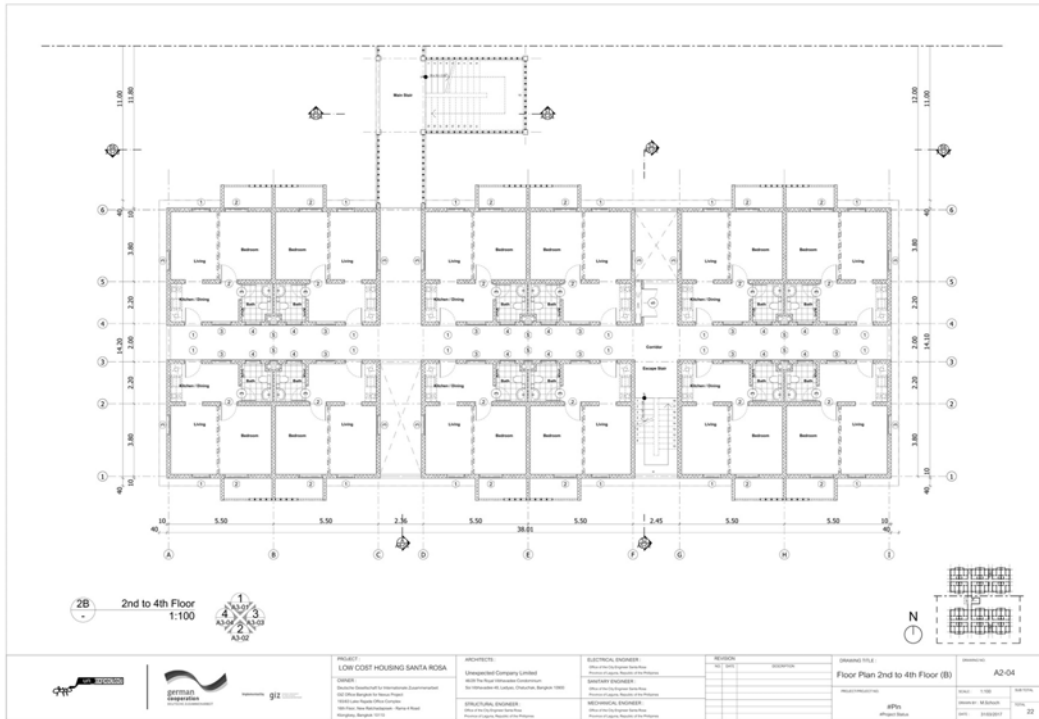
Unexpected Co.Ltd.
 Unexpected Co.Ltd. The Royal Vibhavadi 46/29
 Soi Vibhavadi 48Lad Yao, Chatuchak
 Bangkok, 10900 Thailand

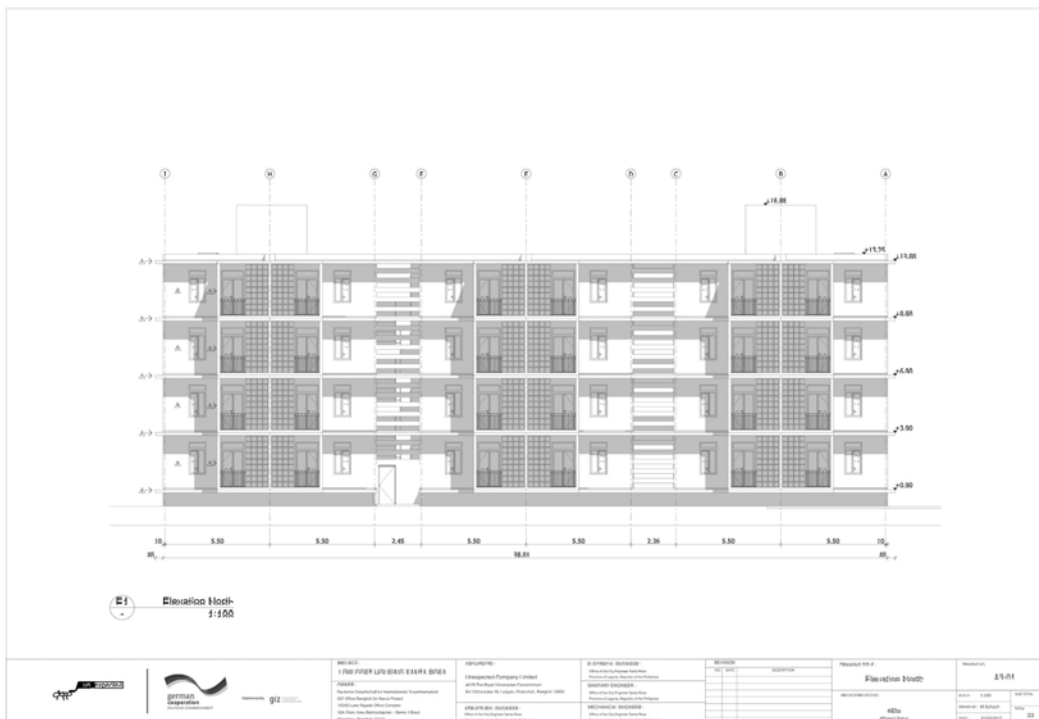
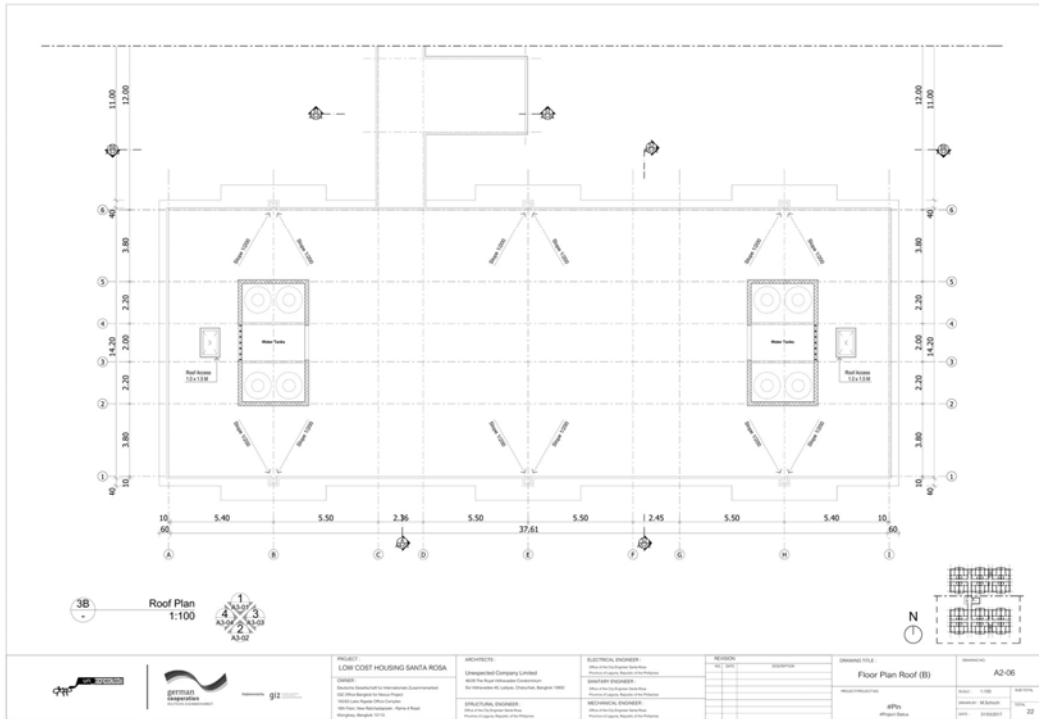
LOW COST HOUSING SANTA ROSA
BUILDING TYPE A
ARCHITECTURAL DRAWING SET

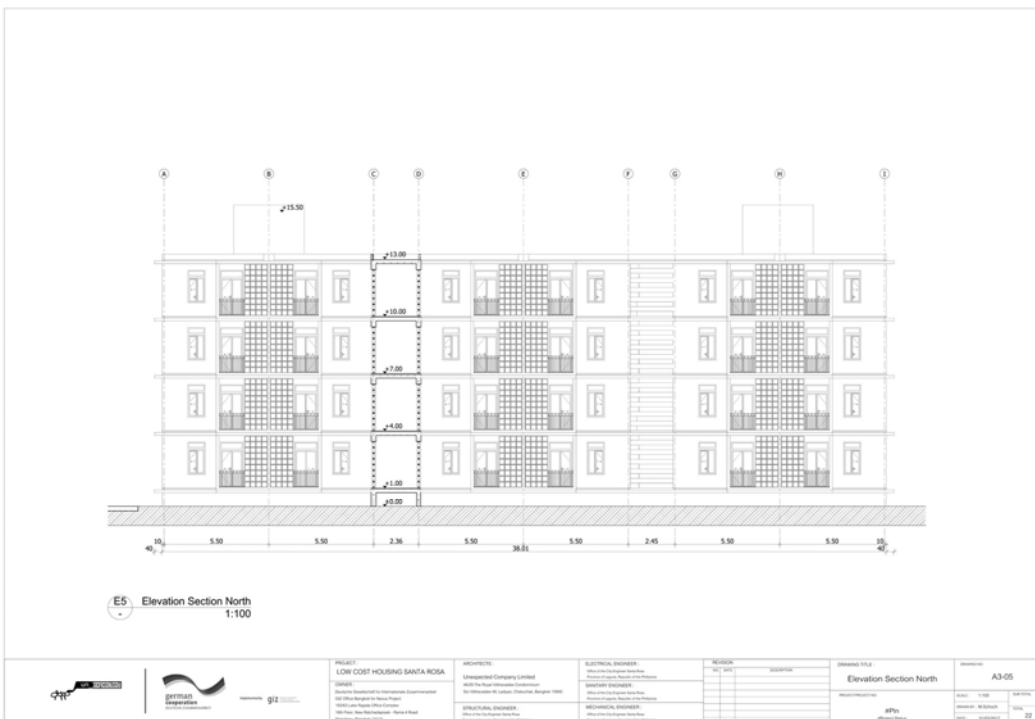
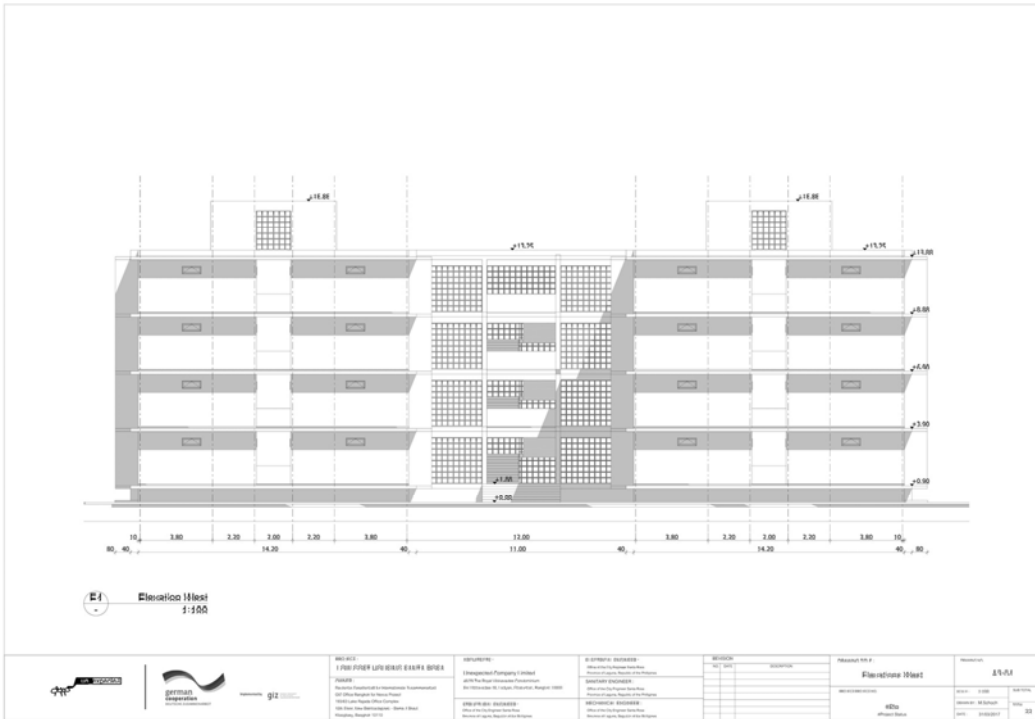
City of Santa Rosa
 Province of Laguna
 Philippines

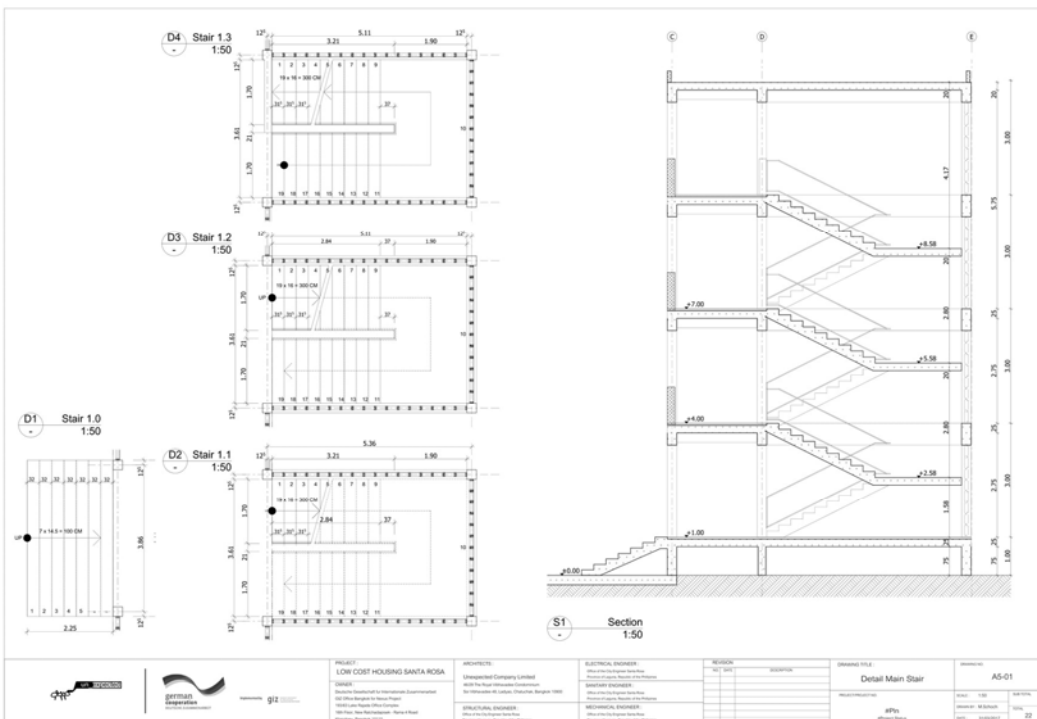
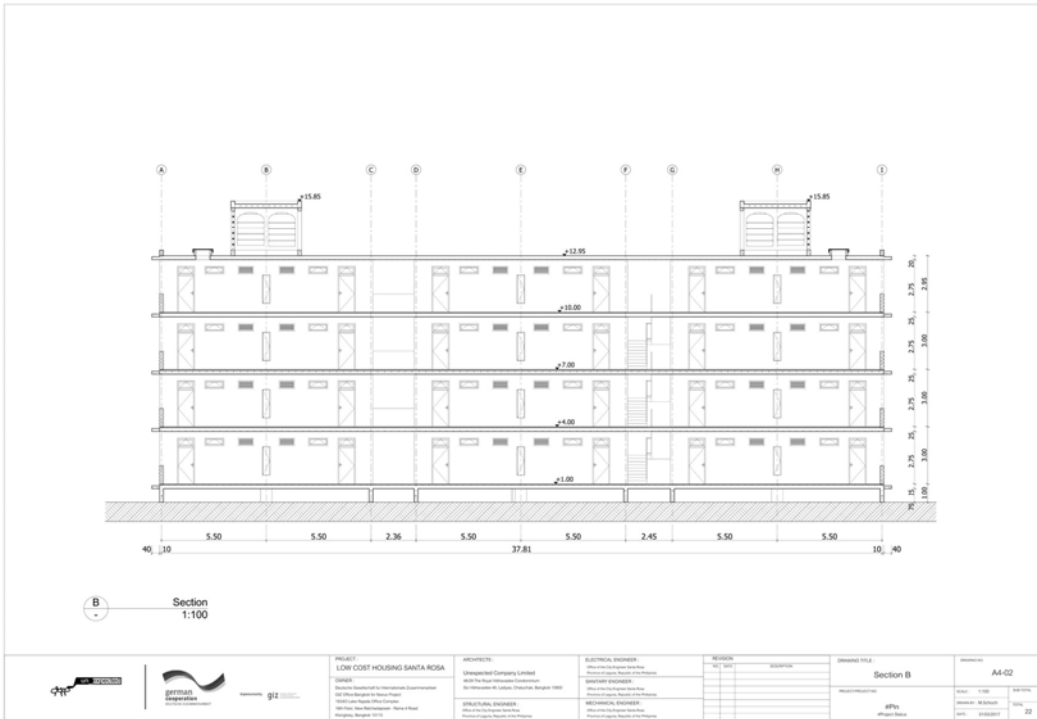
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	Brick Hollow Core, Various Thickness	Sheet	Table of Contents
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	Partition Wall Double Solid	Size	Qty
	Partition Wall Single Solid	Remark	
	Flooring Spm. Marker	AB-01	Core
	Ceiling Spm. Marker	AB-02	Specifications
	Wall Spm. Marker	AB-03	Master Plan
	Door Spm. Marker	AB-04	Room Plan for Floor (1)
	Window Spm. Marker	AB-05	Room Plan for Floor (2)
	Ceiling Spm. Marker	AB-06	Room Plan for Floor (3)
	View Name	AB-07	Room Plan for Floor (4)
	Section Reference	AB-08	Room Plan for Floor (5)
	Detail Reference	AB-09	Room Plan for Floor (6)
	Property Line	AB-10	Room Plan for Floor (7)
	Dimension-Got	AB-11	Room Plan for Floor (8)
	Dimension-Element	AB-12	Room Plan for Floor (9)
	Height Level to Reference +0.00	AB-13	Room Plan for Floor (10)
	North Orientation	AB-14	Room Plan for Floor (11)
	Section Marker	AB-15	Room Plan for Floor (12)
	View Marker	AB-16	Room Plan for Floor (13)
		AB-17	Room Plan for Floor (14)
		AB-18	Room Plan for Floor (15)
		AB-19	Room Plan for Floor (16)
		AB-20	Room Plan for Floor (17)
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		AB-282	Room Plan for

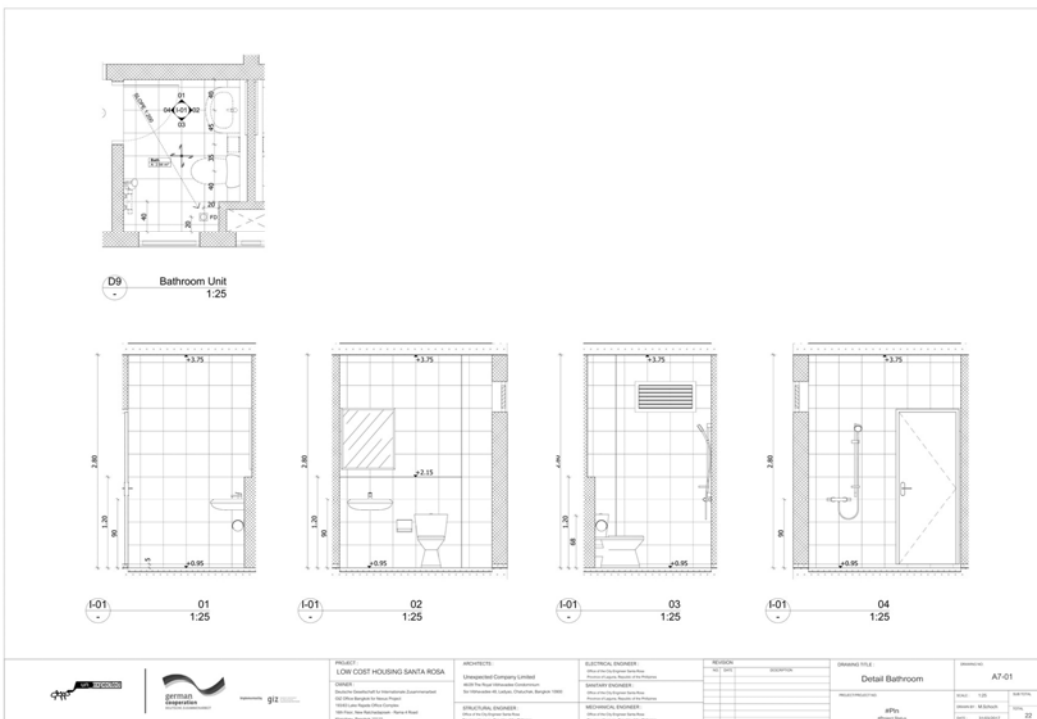
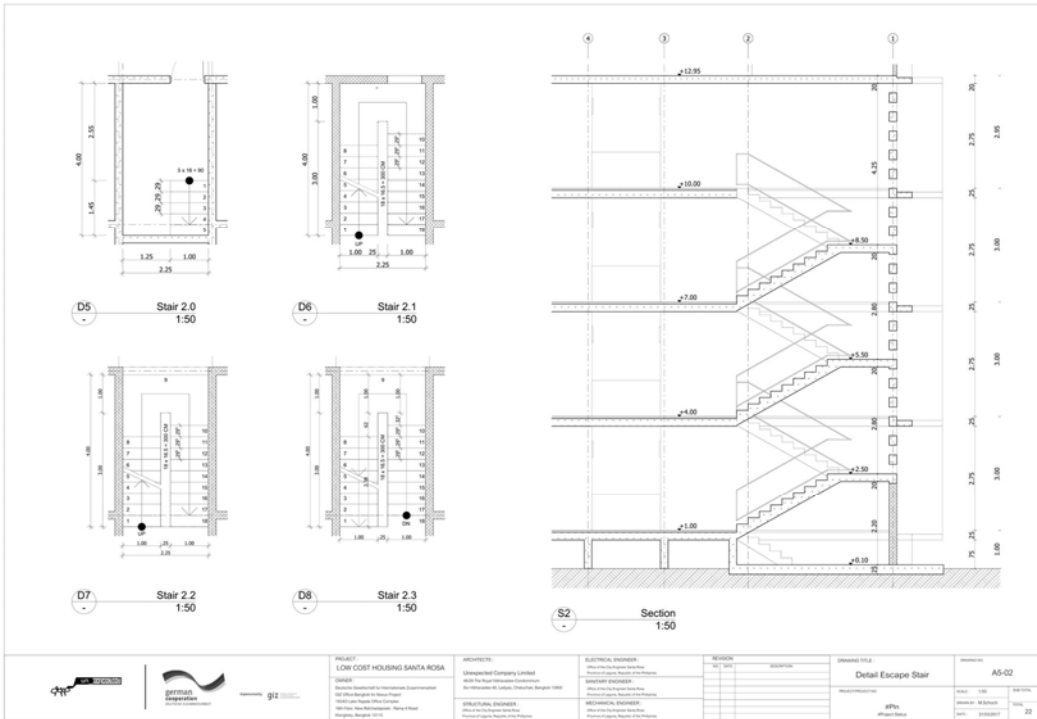












Door List						Window List					
ID	1	2	3	4	5	ID	1	2	3	4	5
Quantity	86	50	86	7	18	Quantity	86	50	86	86	86
Position	Unit	Unit	Unit	Common	Unit	Position	Unit	Unit	Unit	Unit	Unit
Plan View						Plan View					
3D Front View						3D Front View					
Nominal W x H	1.25x2.45	1.25x2.45	1.75x2.45	1.25x2.45	1.25x2.45	Nominal W x H	1.25x2.45	1.25x2.45	1.25x2.45	1.25x2.45	1.25x2.45
Type	Single Door - Hinged with Upper Transom	Single Door - Hinged	Single Door - Hinged with Upper Transom	Single Door - Hinged	Double Door - Hinged	Type	Sliding Frame with upper Transom	Sliding Frame with upper Transom	Sliding Frame with upper Transom	Sliding Frame with upper Transom	Sliding Frame with upper Transom
Door Leaf	Solid UPVC Oak Wood	Solid UPVC Oak Wood	Solid with Transom Glass UPVC Oak Wood	Solid UPVC Oak Wood	Solid UPVC Oak Wood	Transom	None	None	None	None	None
Door Frame	UPVC Oak Wood	UPVC Oak Wood	UPVC Oak Wood	UPVC Oak Wood	UPVC Oak Wood	Frame	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass
Equipment	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	Equipment	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer
Note	Upper Transom with Top Hinged Single Glass				Access Electrical Shaft with Trans. Glass	Note					

	PROJECT: LOW COST HOUSING SANTA ROSA SUBJECT: Building Standard for International Construction 1000 West Park Drive, Santa Rosa 95401, California, USA Project Manager: [Name] Building, Santa Rosa, CA	ARCHITECT: Unexpected Company Limited 400 West Park Drive, Santa Rosa 95401, California, USA STRUCTURAL ENGINEER: [Name] 400 West Park Drive, Santa Rosa 95401, California, USA	ELECTRICAL ENGINEER: [Name] 400 West Park Drive, Santa Rosa 95401, California, USA MECHANICAL ENGINEER: [Name] 400 West Park Drive, Santa Rosa 95401, California, USA	REVISION: NO. 1 DESCRIPTION DATE	DRAWING TITLE: Detail Door Window	REVISION: NO. 1 DATE 2023-07-17
					APPV: [Name]	AS-G1

Unit Furniture Layout						Unit Finishing						Unit Ceiling						Unit Electrical					
ID	1	2	3	4	5	ID	1	2	3	4	5	ID	1	2	3	4	5	ID	1	2	3	4	5
Quantity	86	50	86	7	18	Quantity	86	50	86	86	86	Quantity	86	50	86	86	86	Quantity	86	50	86	86	86
Position	Unit	Unit	Unit	Common	Unit	Position	Unit	Unit	Unit	Unit	Unit	Position	Unit	Unit	Unit	Unit	Unit	Position	Unit	Unit	Unit	Unit	Unit
Plan View						Plan View						Plan View						Plan View					
3D Front View						3D Front View						3D Front View						3D Front View					
Nominal W x H	1.25x2.45	1.25x2.45	1.75x2.45	1.25x2.45	1.25x2.45	Nominal W x H	1.25x2.45	1.25x2.45	1.25x2.45	1.25x2.45	1.25x2.45	Nominal W x H	1.25x2.45	1.25x2.45	1.25x2.45	1.25x2.45	1.25x2.45	Nominal W x H	1.25x2.45	1.25x2.45	1.25x2.45	1.25x2.45	1.25x2.45
Type	Single Door - Hinged with Upper Transom	Single Door - Hinged	Single Door - Hinged with Upper Transom	Single Door - Hinged	Double Door - Hinged	Type	Sliding Frame with upper Transom	Sliding Frame with upper Transom	Sliding Frame with upper Transom	Sliding Frame with upper Transom	Sliding Frame with upper Transom	Type	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Type	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass
Door Leaf	Solid UPVC Oak Wood	Solid UPVC Oak Wood	Solid with Transom Glass UPVC Oak Wood	Solid UPVC Oak Wood	Solid UPVC Oak Wood	Door Leaf	None	None	None	None	None	Door Leaf	None	None	None	None	None	Door Leaf	None	None	None	None	None
Door Frame	UPVC Oak Wood	UPVC Oak Wood	UPVC Oak Wood	UPVC Oak Wood	UPVC Oak Wood	Door Frame	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Door Frame	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Door Frame	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass	Sliding Frame - Single Glass
Equipment	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	Equipment	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	Equipment	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	Equipment	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer	TSC Manufacturer
Note	Upper Transom with Top Hinged Single Glass				Access Electrical Shaft with Trans. Glass	Note						Note						Note					

	PROJECT: LOW COST HOUSING SANTA ROSA SUBJECT: Building Standard for International Construction 1000 West Park Drive, Santa Rosa 95401, California, USA Project Manager: [Name] Building, Santa Rosa, CA	ARCHITECT: Unexpected Company Limited 400 West Park Drive, Santa Rosa 95401, California, USA STRUCTURAL ENGINEER: [Name] 400 West Park Drive, Santa Rosa 95401, California, USA	ELECTRICAL ENGINEER: [Name] 400 West Park Drive, Santa Rosa 95401, California, USA MECHANICAL ENGINEER: [Name] 400 West Park Drive, Santa Rosa 95401, California, USA	REVISION: NO. 1 DESCRIPTION DATE	DRAWING TITLE: App. Unit Detail	REVISION: NO. 1 DATE 2023-07-17
					APPV: [Name]	AS-G1

BUILDING TYPE B – HOUSING FOR INFORMAL SETTLER



Unexpected Co. Ltd.
 Unexpected Co. Ltd. The Royal Vibhavadi 46/29
 Soi Vibhavadi 48Lad Yao, Chatuchak
 Bangkok, 10900 Thailand

LOW COST HOUSING SANTA ROSA
BUILDING TYPE B
ARCHITECTURE APPROVAL SET

City of Santa Rosa
 Province of Laguna
 Philippines

Legend Material Specifications	Drawing Set Architecture	Table of Content																																																																																																																																																																																																																																																																																																																																																																													
<ul style="list-style-type: none"> Black Hollow Cor. Various Thickness Structural Concrete Reinforced Concrete Partition Wall Double Sided Partition Wall Single Sided 	<table border="1"> <thead> <tr> <th>Sheet</th> <th>Layer Name</th> <th>Size</th> <th>No</th> <th>Remark</th> </tr> </thead> <tbody> <tr><td>AD-01</td><td>Client</td><td>300 x 420</td><td>01</td><td></td></tr> <tr><td>AD-02</td><td>Specifications</td><td>300 x 420</td><td>02</td><td></td></tr> <tr><td>AD-03</td><td>Master Plan</td><td>300 x 420</td><td>03</td><td></td></tr> <tr><td>AD-04</td><td>Floor Plan (2nd to 4th Floor)</td><td>300 x 420</td><td>04</td><td></td></tr> <tr><td>AD-05</td><td>Floor Plan (1st Floor)</td><td>300 x 420</td><td>05</td><td></td></tr> <tr><td>AD-06</td><td>Floor Plan (0th Floor)</td><td>300 x 420</td><td>06</td><td></td></tr> <tr><td>AD-07</td><td>Floor Plan (Roof)</td><td>300 x 420</td><td>07</td><td></td></tr> <tr><td>AD-08</td><td>Elevation North</td><td>300 x 420</td><td>08</td><td></td></tr> <tr><td>AD-09</td><td>Elevation South</td><td>300 x 420</td><td>09</td><td></td></tr> <tr><td>AD-10</td><td>Elevation East</td><td>300 x 420</td><td>10</td><td></td></tr> <tr><td>AD-11</td><td>Elevation West</td><td>300 x 420</td><td>11</td><td></td></tr> <tr><td>AD-12</td><td>Elevation Section North</td><td>300 x 420</td><td>12</td><td></td></tr> <tr><td>AD-13</td><td>Elevation Section South</td><td>300 x 420</td><td>13</td><td></td></tr> <tr><td>AD-14</td><td>Section A</td><td>300 x 420</td><td>14</td><td></td></tr> <tr><td>AD-15</td><td>Section B</td><td>300 x 420</td><td>15</td><td></td></tr> <tr><td>AD-16</td><td>Section C</td><td>300 x 420</td><td>16</td><td></td></tr> <tr><td>AD-17</td><td>Detail Plan Stair</td><td>300 x 420</td><td>17</td><td></td></tr> <tr><td>AD-18</td><td>Detail Staircase Stair</td><td>300 x 420</td><td>18</td><td></td></tr> <tr><td>AD-19</td><td>App. the Detail</td><td>300 x 420</td><td>19</td><td></td></tr> <tr><td>AD-20</td><td>Detail Bathroom</td><td>300 x 420</td><td>20</td><td></td></tr> <tr><td>AD-21</td><td>Detail Doors / Windows</td><td>300 x 420</td><td>21</td><td></td></tr> </tbody> </table>	Sheet	Layer Name	Size	No	Remark	AD-01	Client	300 x 420	01		AD-02	Specifications	300 x 420	02		AD-03	Master Plan	300 x 420	03		AD-04	Floor Plan (2nd to 4th Floor)	300 x 420	04		AD-05	Floor Plan (1st Floor)	300 x 420	05		AD-06	Floor Plan (0th Floor)	300 x 420	06		AD-07	Floor Plan (Roof)	300 x 420	07		AD-08	Elevation North	300 x 420	08		AD-09	Elevation South	300 x 420	09		AD-10	Elevation East	300 x 420	10		AD-11	Elevation West	300 x 420	11		AD-12	Elevation Section North	300 x 420	12		AD-13	Elevation Section South	300 x 420	13		AD-14	Section A	300 x 420	14		AD-15	Section B	300 x 420	15		AD-16	Section C	300 x 420	16		AD-17	Detail Plan Stair	300 x 420	17		AD-18	Detail Staircase Stair	300 x 420	18		AD-19	App. the Detail	300 x 420	19		AD-20	Detail Bathroom	300 x 420	20		AD-21	Detail Doors / Windows	300 x 420	21		<p>Overview Electrical Installation</p> <table border="1"> <thead> <tr> 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