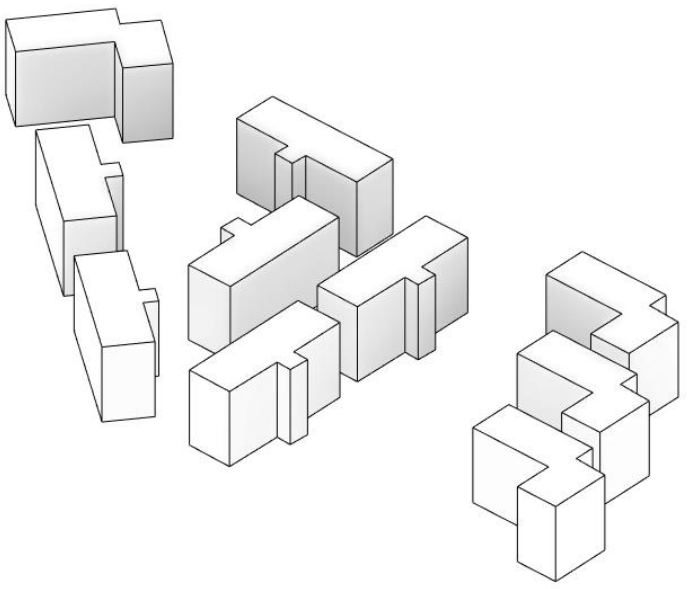

Residential Density

Addis Ababa

Elias Yitbarek Alemayehu
Dula Alemu Dinku

EiABC

Ethiopian Institute of Architecture,
Building Construction and City Development
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Residential Density

Addis Ababa

Legend

Net Residential Density Study Sites

Gross Residential Density Study Sites

↑N

0 0.75 1.5 3 4.5 6 Kilometers

Contents

Acknowledgment

Housing chair, Promoter
ATK Building Investment plc., Sponsor

Abbreviations

BAR: Builtup Area Ratio
DU: Dwelling unit
DU/Ha: Dwelling unit per Hectare
GRD: Gross Residential Density
Ha: Hectare
NRD: Net Residential Density
SP: Structural Plan
UN-Habitat: United Nations Human Settlement Programme

Introduction

This study is about the residential density of various areas of Addis Ababa. It is based on student works resulting from assignments given to them during a course entitled “Introduction to Housing/Urban Housing”. It is a result of three consecutive years undertaken by different student groups. The student works were extensively revised both in terms of content and presentation. The content was checked for accuracy, at times requiring recalculation, and additional density parameters were added to make it more informative. Likewise, all graphics including drawings and photographs were re-done adding more information and harmonizing discrepancies. Further analysis was made and findings generated.

Residential density is one type of measurement showing how dense or sparse a given residential settlement is. It is a critical attribute determining the quality of life in urban areas and beyond. Thus, it is often included in urban plans as part of a zoning ordinance prepared by municipalities. We chose to dwell on the issue of density for the fact that the physical dimension of a city has a decisive impact on its economic, social and environmental performance. In cities such as Addis Ababa this becomes even more pronounced because the land within its administrative boundaries is nearly all occupied. The city seems to have no option but to grow vertically, both on the little remaining vacant land, by infill in existing compounds and redeveloping built-up areas. The question remains how dense it should be; which is often connected how high we should build? In order to inform this question, we opted to first understand the existing density of selected settlements within Addis Ababa and compare it with both locally and internationally available standards.

The Addis Ababa city structure plan (2017-2027) gives standard for gross residential density, but not net density. In this booklet, however, Section-1 deals with net density of various clusters of residential areas while Section-2 deals with gross density of neighborhoods. The findings of the net densities are then compared with international standards while that of gross density with the Structure Plan. Data analysis is made in Section 3 and findings generated; while Section 4 concludes by synthesizing the findings. In dealing with residential density we have considered the following operational definitions:

Net Residential Density (NRD) : a measure of dwelling units per an area identified as residential including access ways, playgrounds, and immediate facilities. In other terms, as a measure of available dwelling units per an area earmarked as a residential area.
Gross Residential Density (GRD): a proportion of the number of dwelling units in a given area and the total area of the site including services and facilities serving a larger community beyond immediate residents.

The issue of density goes beyond a simple calculation and is a more complex concept than often perceived by practitioners and policy makers. It can vary greatly depending on, to mention but few, the unit of analysis (housing units, households, population, crowding) and the spatial scale (building, block, cluster, neighborhood, city). These variables may sometimes lead to contradictory findings, of which such discussion is beyond the scope of this booklet. It is our hope that this preliminary initiative to document residential density would contribute, in a small way, towards the need of Addis Ababa to become a compact and livable city.

Section I Net Residential Density

Location map of Net Residential Study Sites

Legend

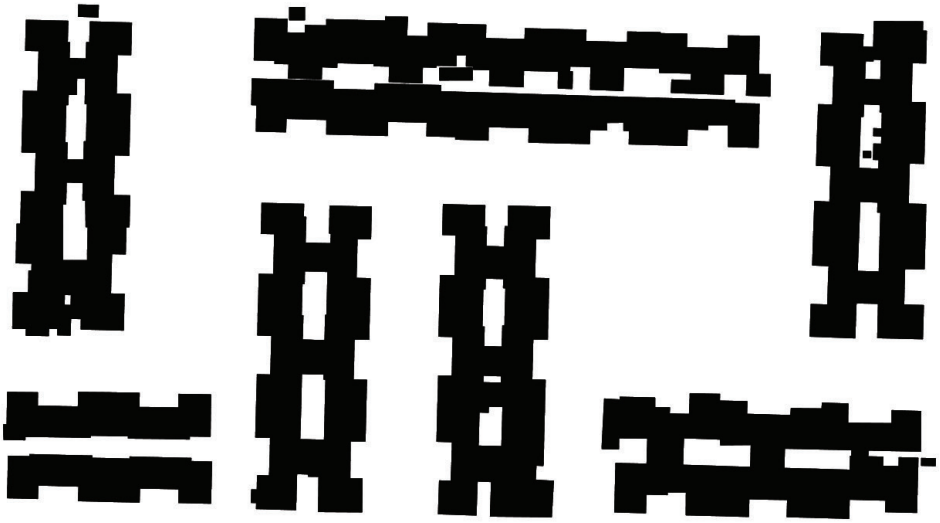
Net Residential Density Study Sites

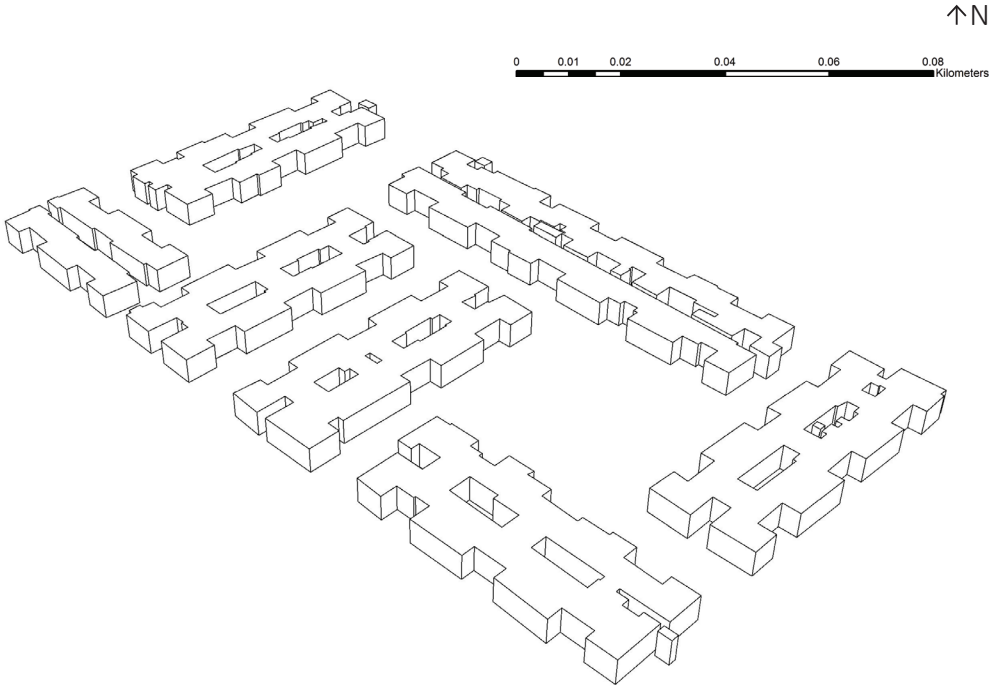
Kilometers
0 0.75 1.5 3 4.5 6

01 Ayer Menged Maheber

Housing type	Cooperative housing
Area (Ha)	2.48
No. of Blocks	1
No. of floors	2 and 3
No. of dwelling units	88
NRD	36
BAR (%)	32.7

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	Low

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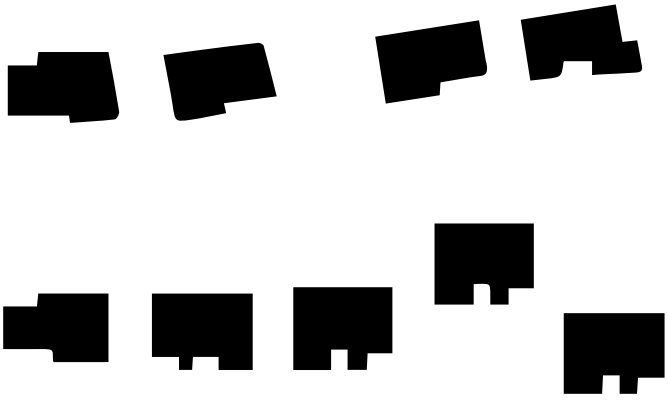
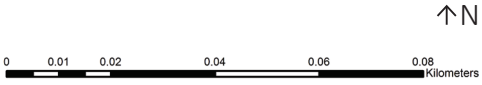
02 Berta

Housing type	Real estate
Area (Ha)	1.2
No. of Blocks	1
No. of floors	2
No. of dwelling units	9
NRD	8
BAR (%)	16.5

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	Very Low

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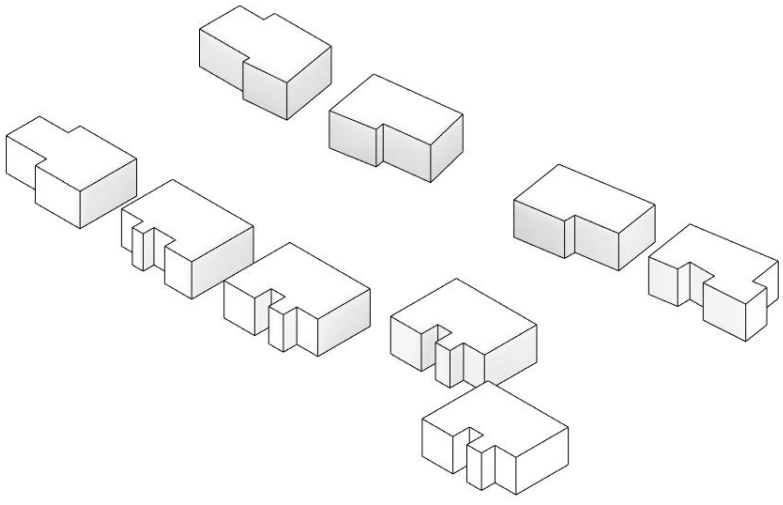
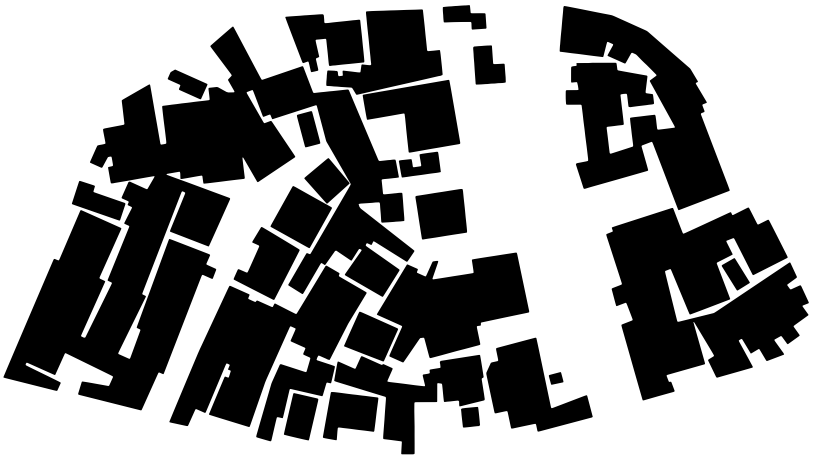


03 Geja Sefer

Housing type	Kebele housing
Area (Ha)	1.23
No. of Blocks	2
No. of floors	1
No. of dwelling units	44
NRD	36
BAR (%)	52

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
High-Density Mixed Residence	Low



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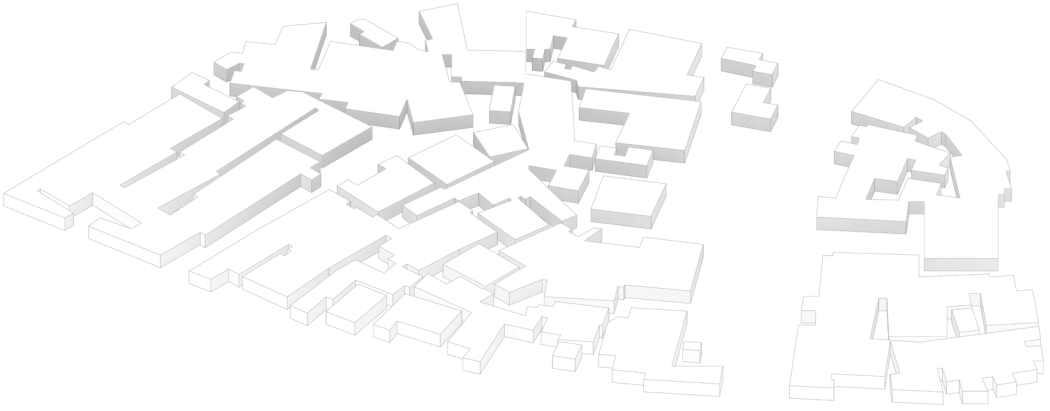
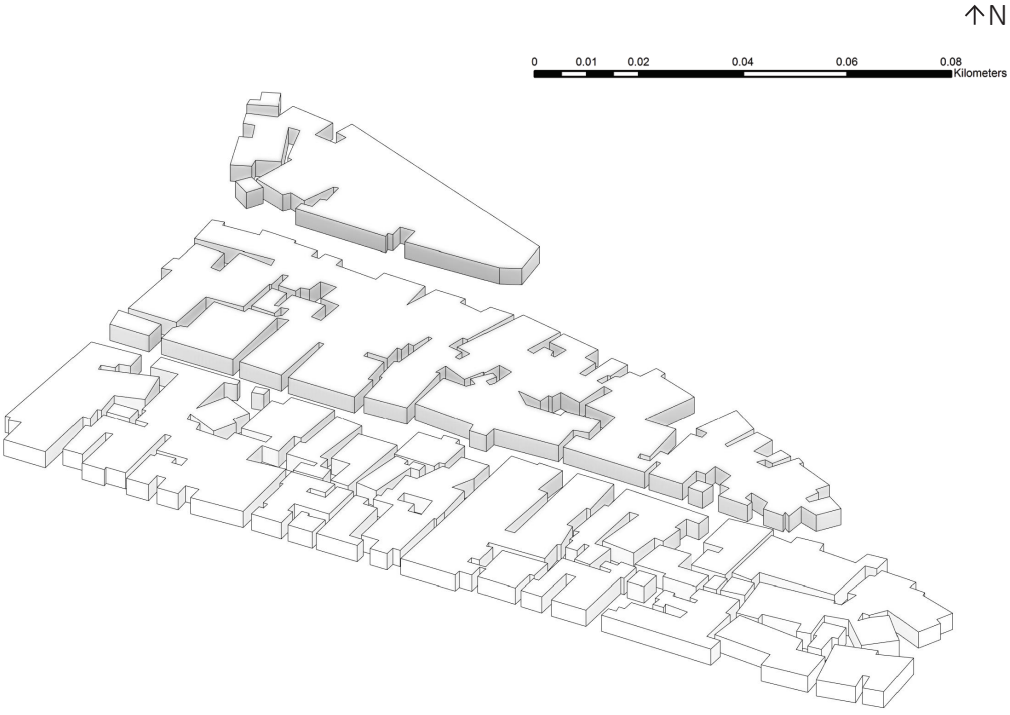


04 Berbere Tera

Housing type	Upgraded kebele housing
Area (Ha)	1.36
No. of Blocks	3
No. of floors	1
No. of dwelling units	51
NRD	38
BAR (%)	57

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
High-Density Mixed Residence	Low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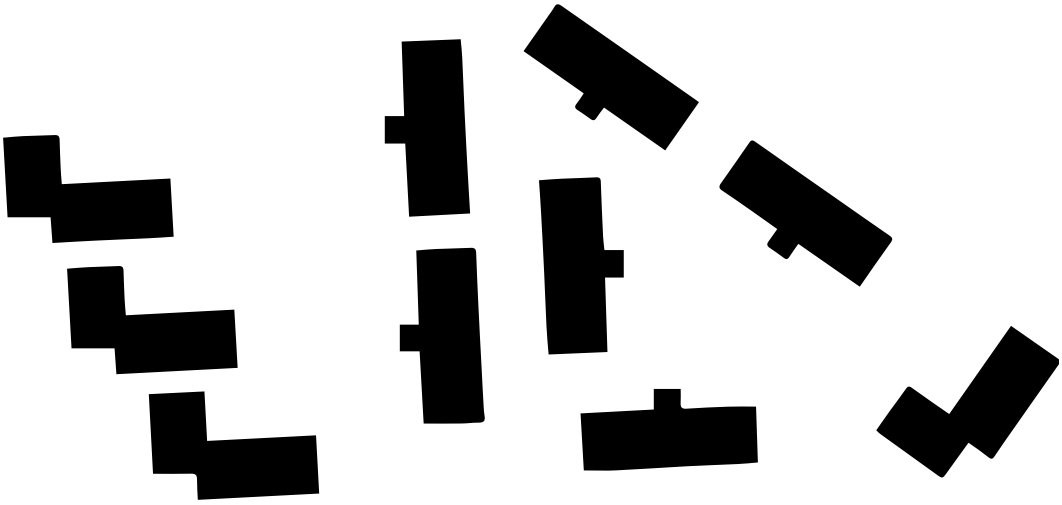
05 Jemo 1

Housing type	Condominium 20/80
Area (Ha)	1.43
No. of Blocks	1
No. of floors	5
No. of dwelling units	200
NRD	143
BAR (%)	18

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	High



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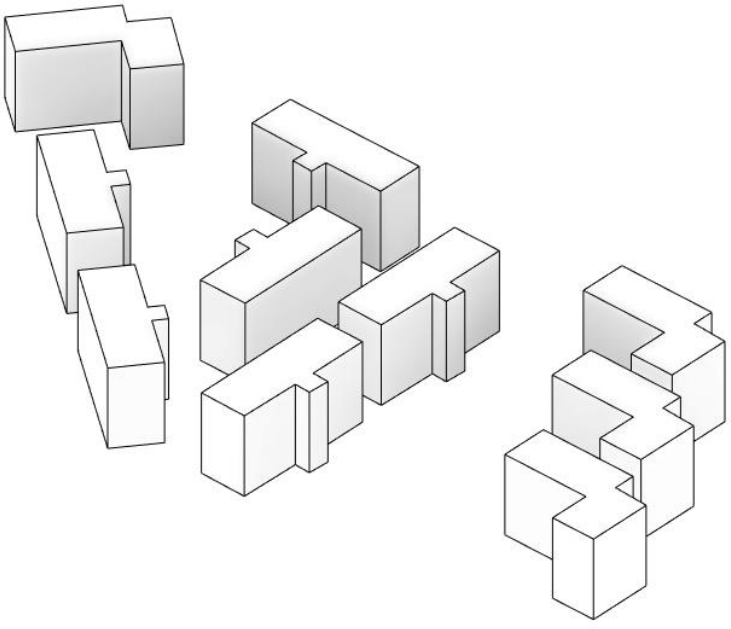
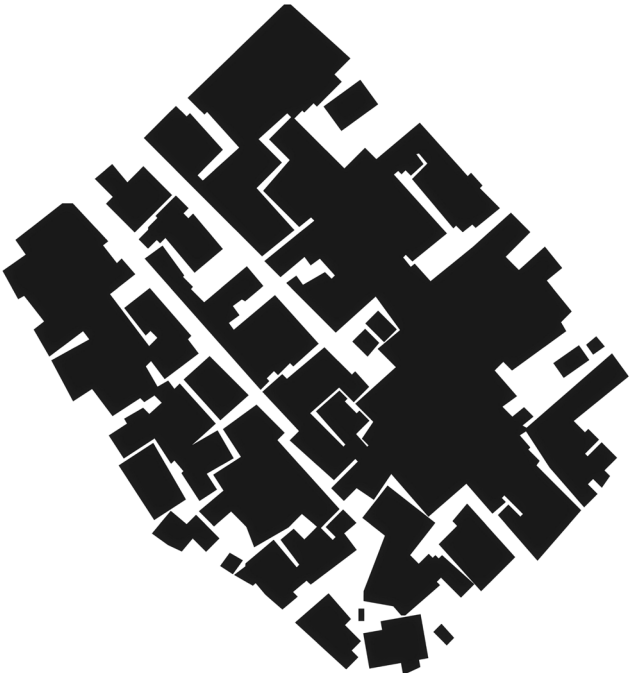


06 Sarbet Kebele 08

Housing type	Kebele housing
Area (Ha)	1.25
No. of Blocks	1
No. of floors	1
No. of dwelling units	44
NRD	35
BAR (%)	59.2

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Medium-Density Mixed Residence	Low



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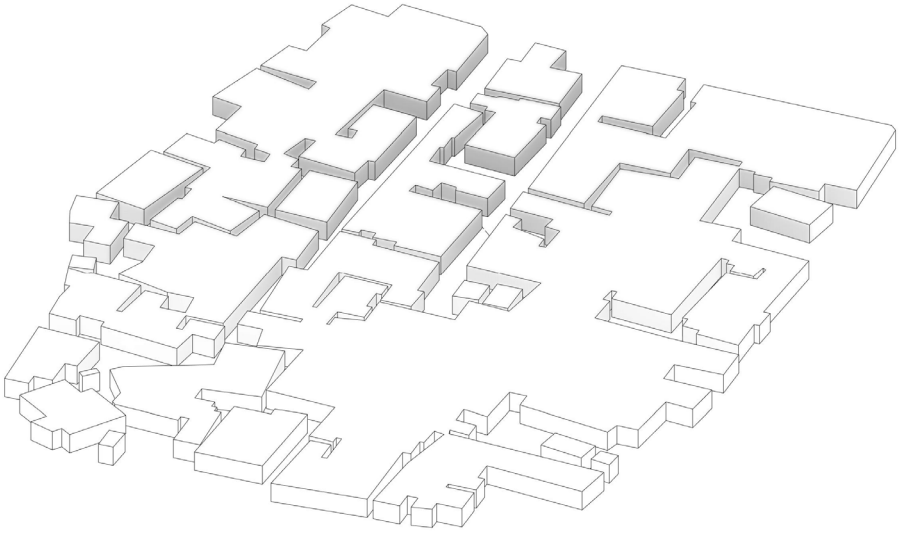
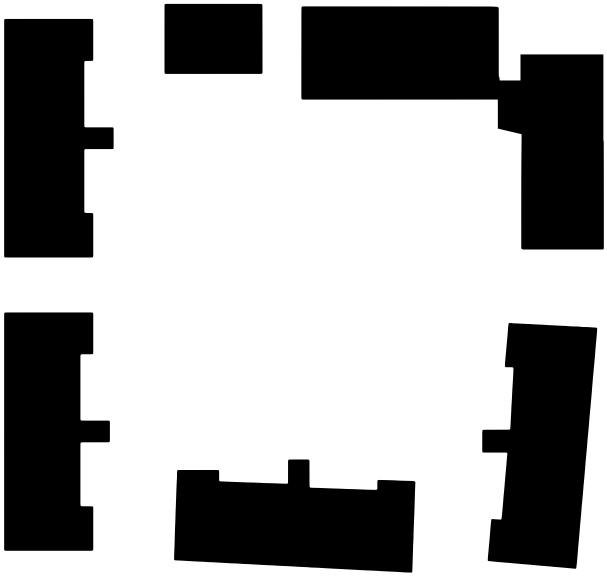
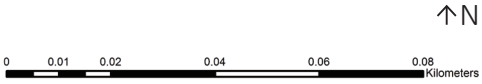


07 Mickey Leland

Housing type	Condominium 20/80
Area (Ha)	0.91
No. of Blocks	1
No. of floors	5
No. of dwelling units	180
NRD	197
BAR (%)	21.6

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	High

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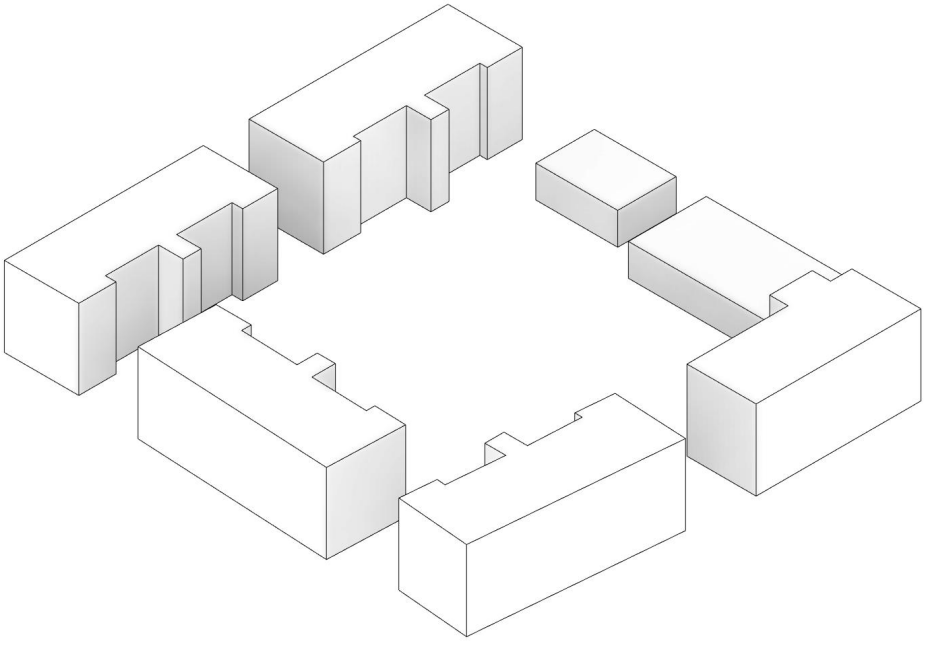
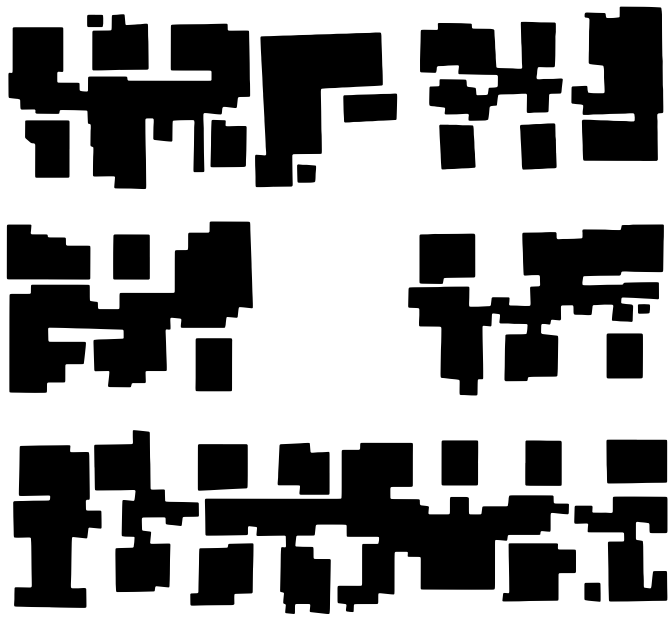


08 Kolfe Keranio

Housing type	Cooperative housing
Area (Ha)	1.79
No. of Blocks	3
No. of floors	1
No. of dwelling units	80
NRD	45
BAR (%)	37.4

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	Medium



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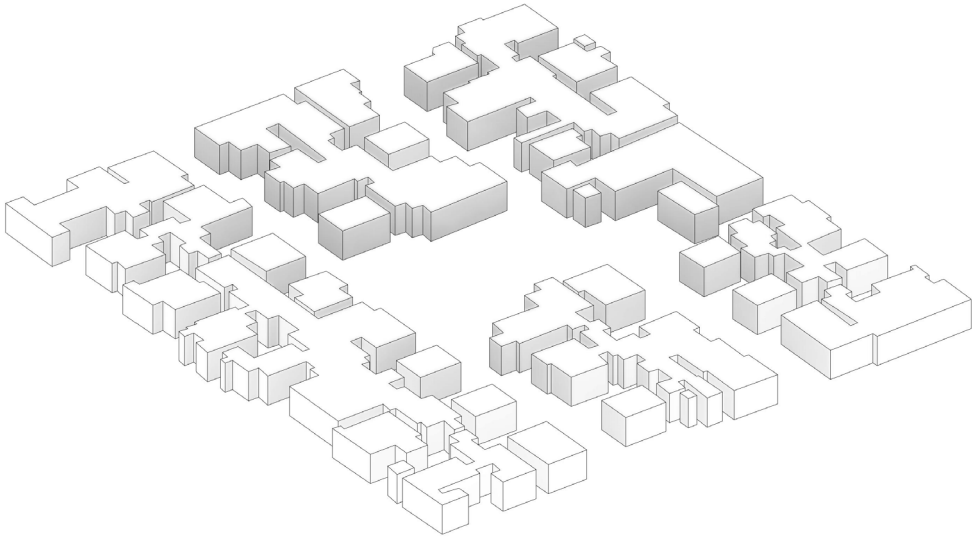

09 CMC, Safari Village

Housing type	Formal private housing
Area (Ha)	2.18
No. of Blocks	4
No. of floors	2
No. of dwelling units	49
NRD	23
BAR (%)	29.4

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence & High-Density Mixed Residence	Low

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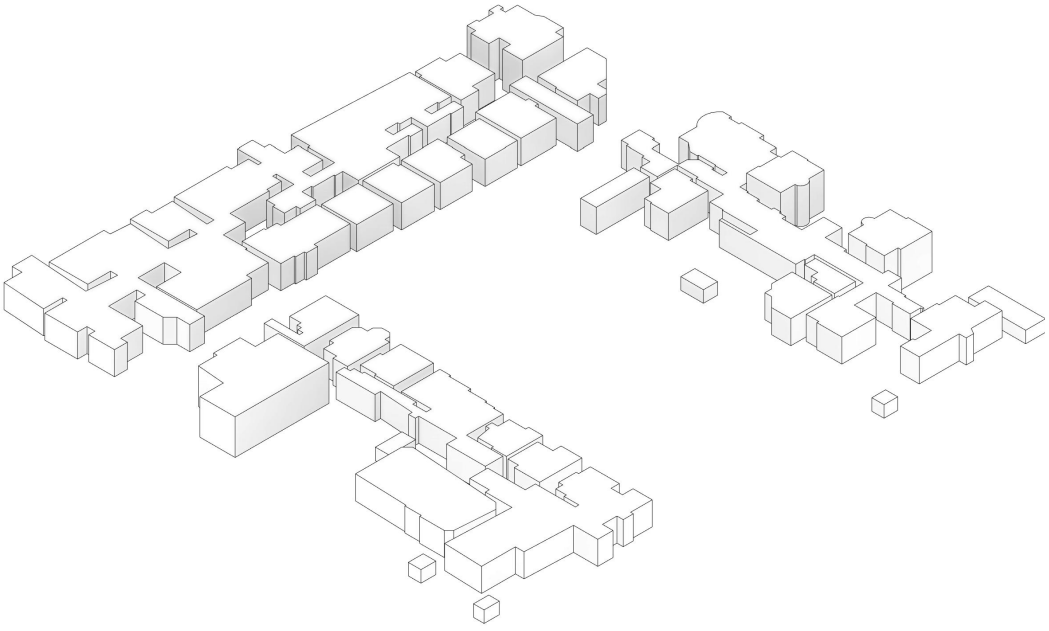
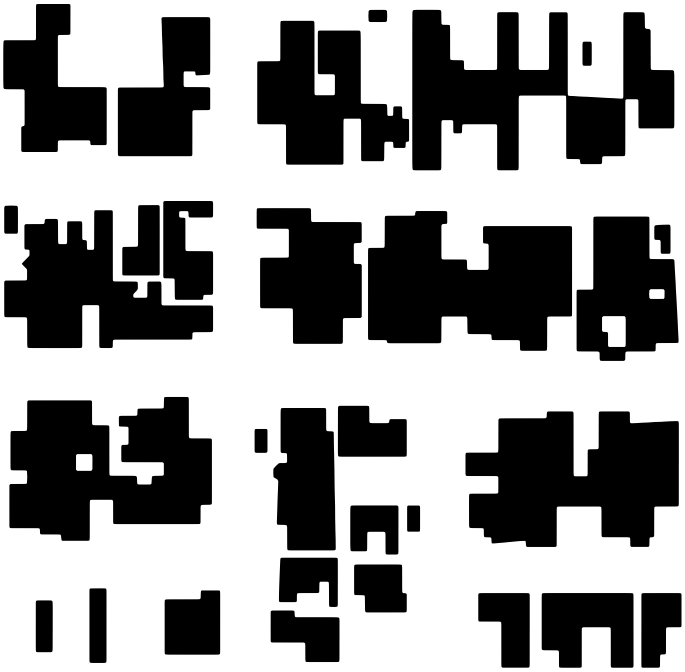


10 Gerji Mebirat Hayil

Housing type	Informal private housing
Area (Ha)	1.98
No. of Blocks	9
No. of floors	1
No. of dwelling units	89
NRD	45
BAR (%)	29.6

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	Medium



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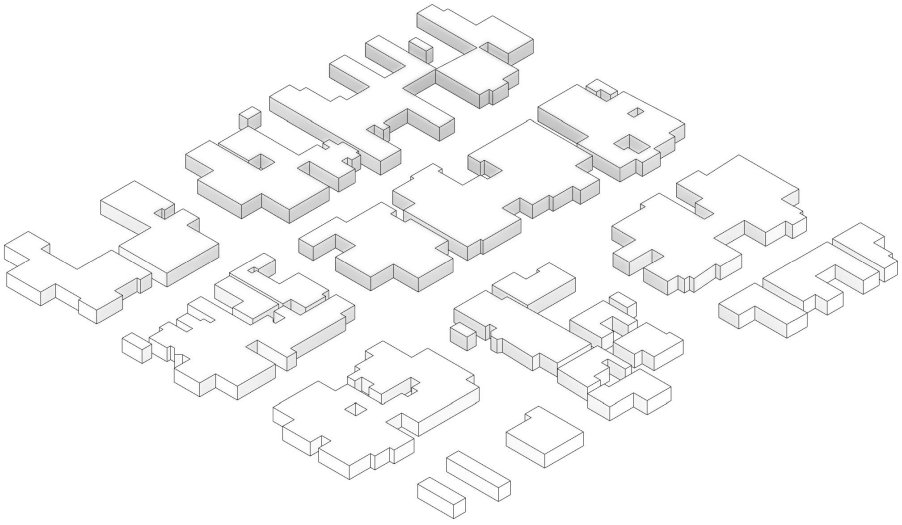
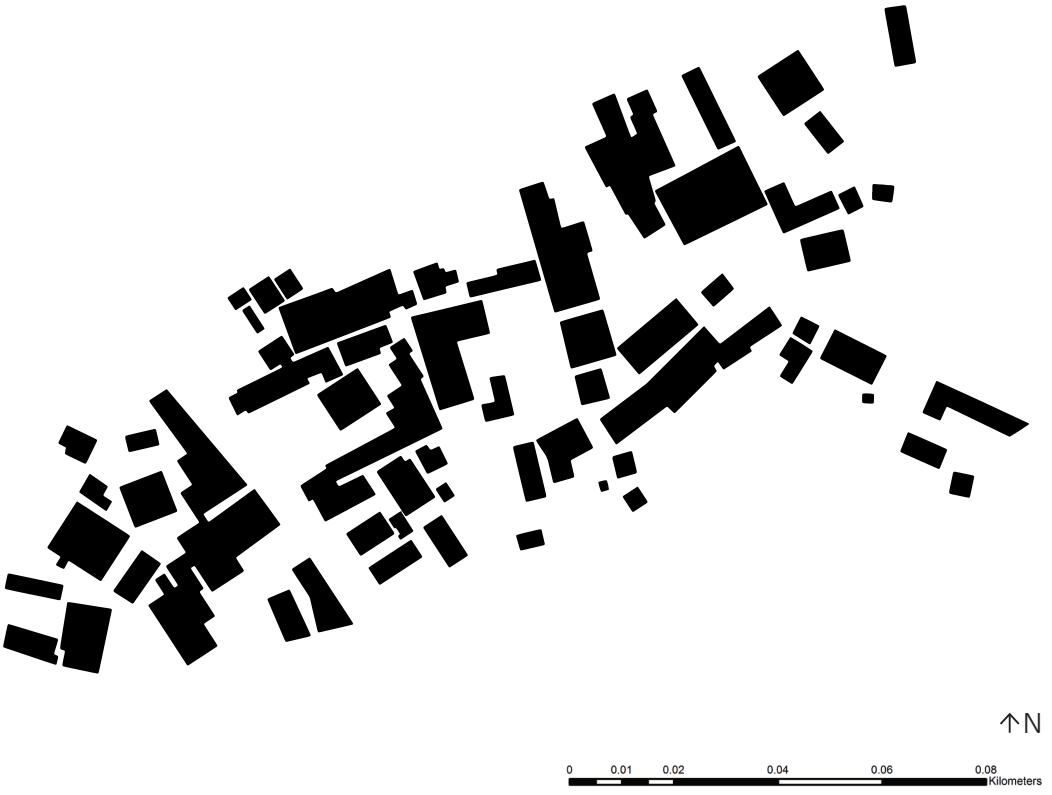


11 Karalo

Housing type	Informal Private housing
Area (Ha)	1.32
No. of Blocks	2
No. of floors	1
No. of dwelling units	116
NRD	88
BAR (%)	22.6

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	Medium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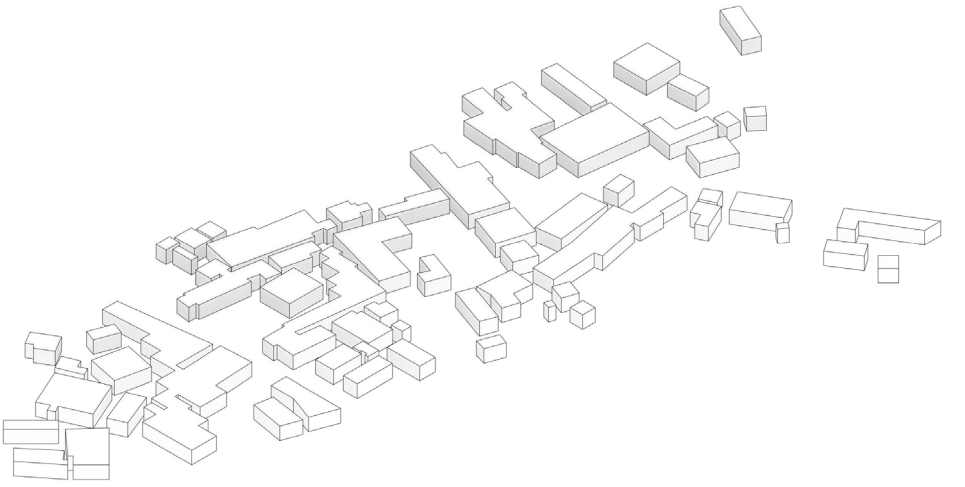

12 Addisu Gebeya

Housing type	Formal private housing
Area (Ha)	1.09
No. of Blocks	1 and 2
No. of floors	1.5
No. of dwelling units	23
NRD	21
BAR (%)	45.9

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Medium-Density Mixed Residence	Low

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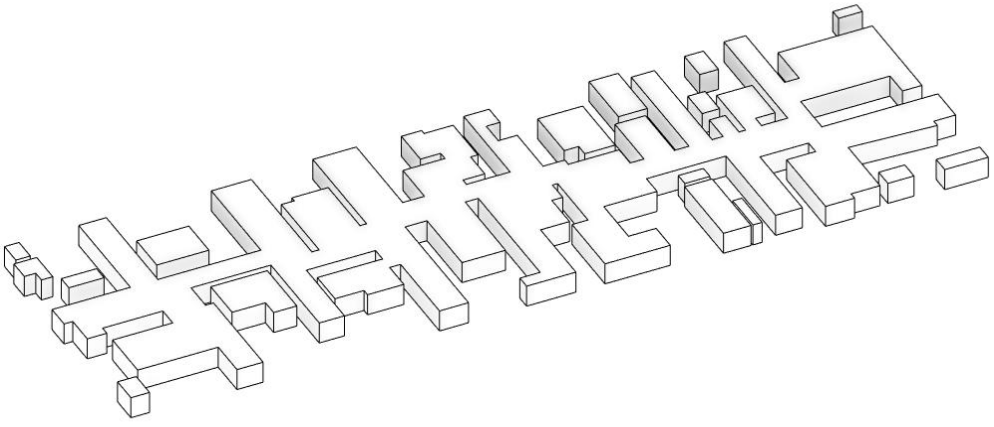
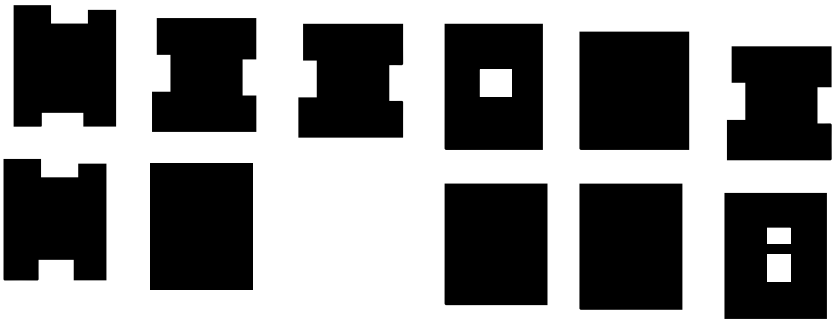


13 CMC, St. Michael Church

Housing type	Cooperative housing
Area (Ha)	1.25
No. of Blocks	1
No. of floors	5
No. of dwelling units	220
NRD	176
BAR (%)	38.6

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	High



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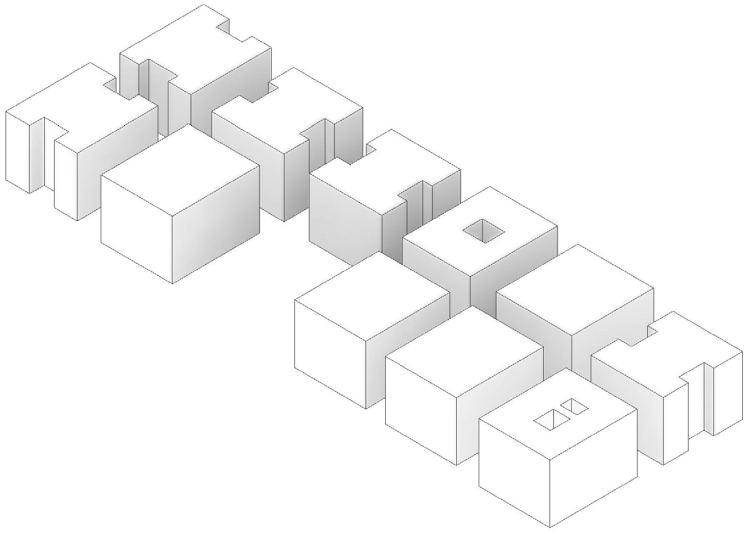
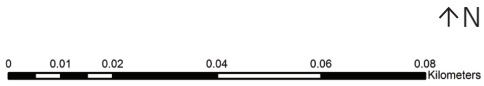


14 Sefere Genet

Housing type	Regularized informal private housing
Area (Ha)	0.84
No. of Blocks	1
No. of floors	1
No. of dwelling units	16
NRD	19
BAR (%)	13.7

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	Low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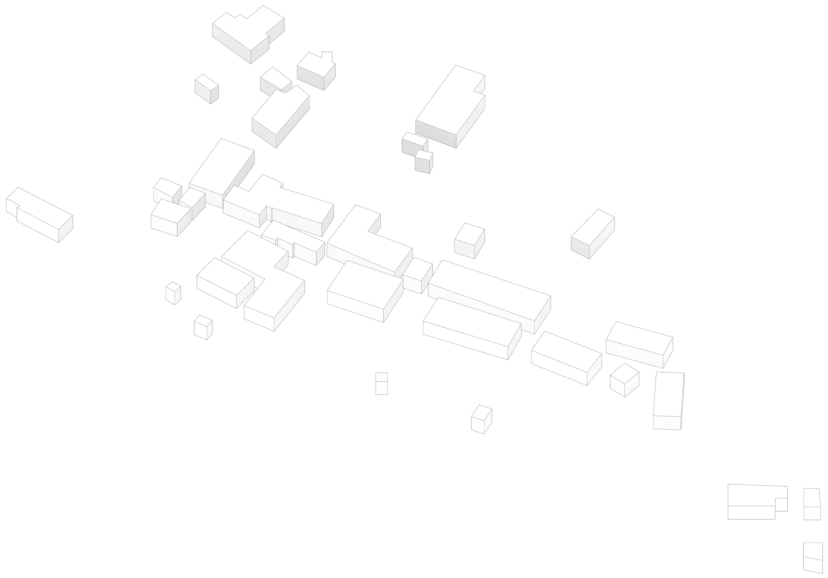
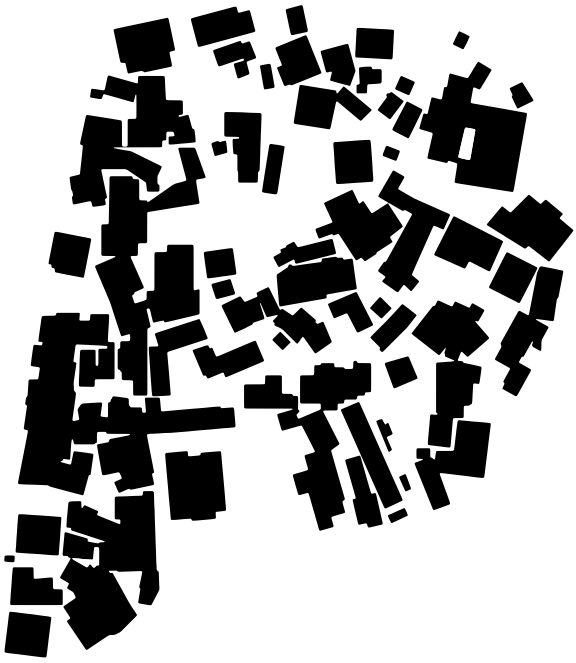


15 Menen 1

Housing type	Upgraded kebele housing
Area (Ha)	1.01
No. of Blocks	1
No. of floors	2
No. of dwelling units	157
NRD	155
BAR (%)	45.6

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Medium-Density Mixed Residence	High



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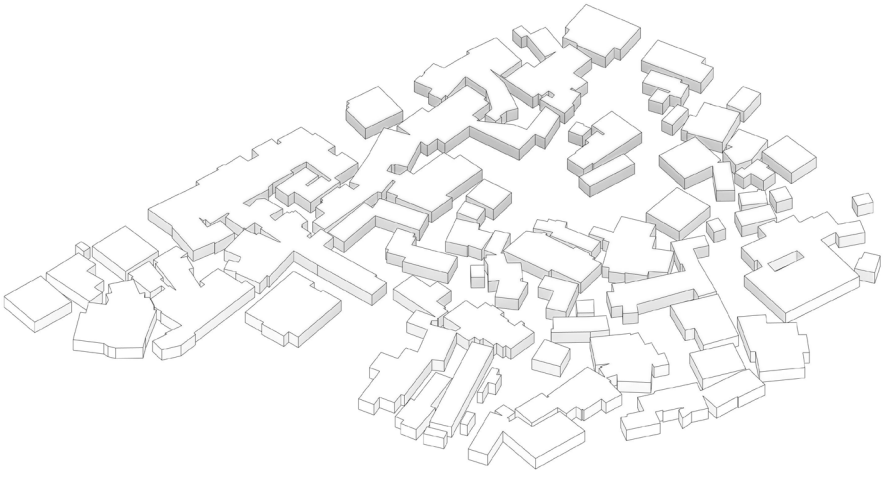

16 Menen 2

Housing type	Upgraded kebele housing
Area (Ha)	1.01
No. of Blocks	1
No. of floors	2
No. of dwelling units	204
NRD	204
BAR (%)	37.1

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Medium-Density Mixed Residence	High

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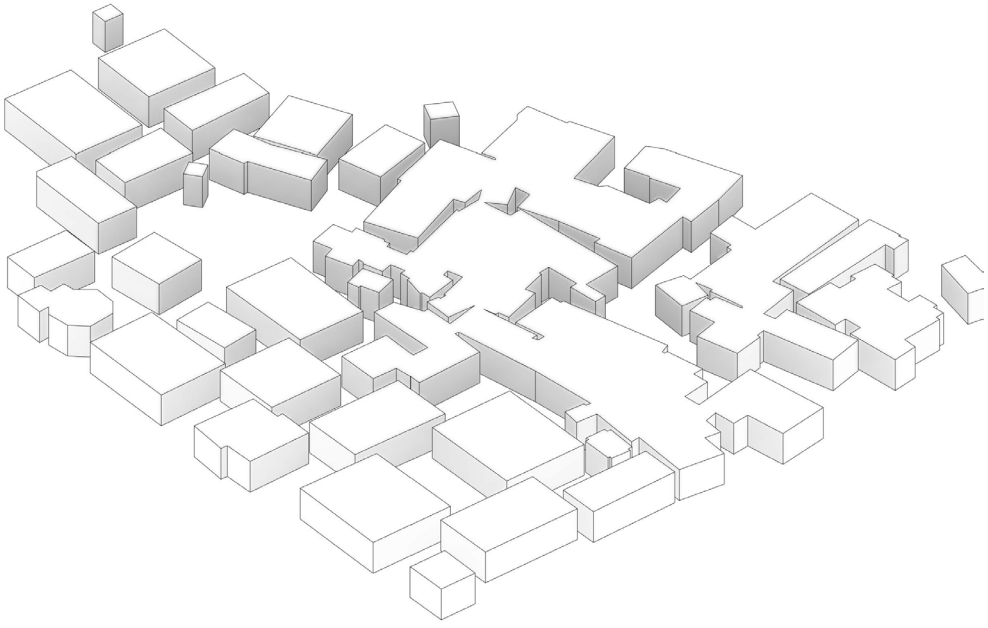
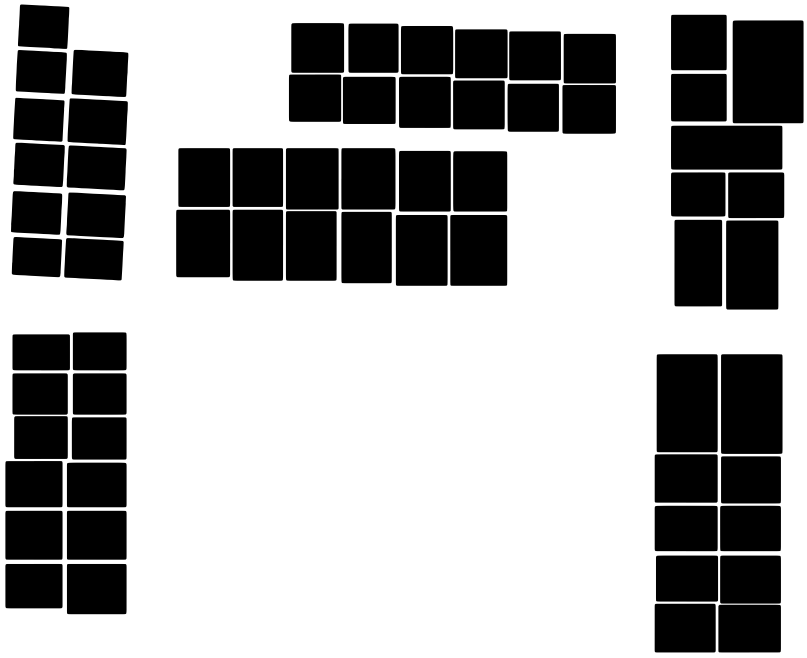
Kilometers

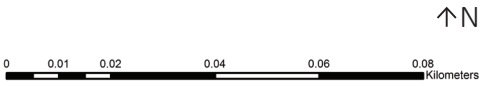


17 CMC

Housing type	Cooperative housing
Area (Ha)	1.6
No. of Blocks	1
No. of floors	2 - 4
No. of dwelling units	69
NRD	43
BAR (%)	32

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	Medium

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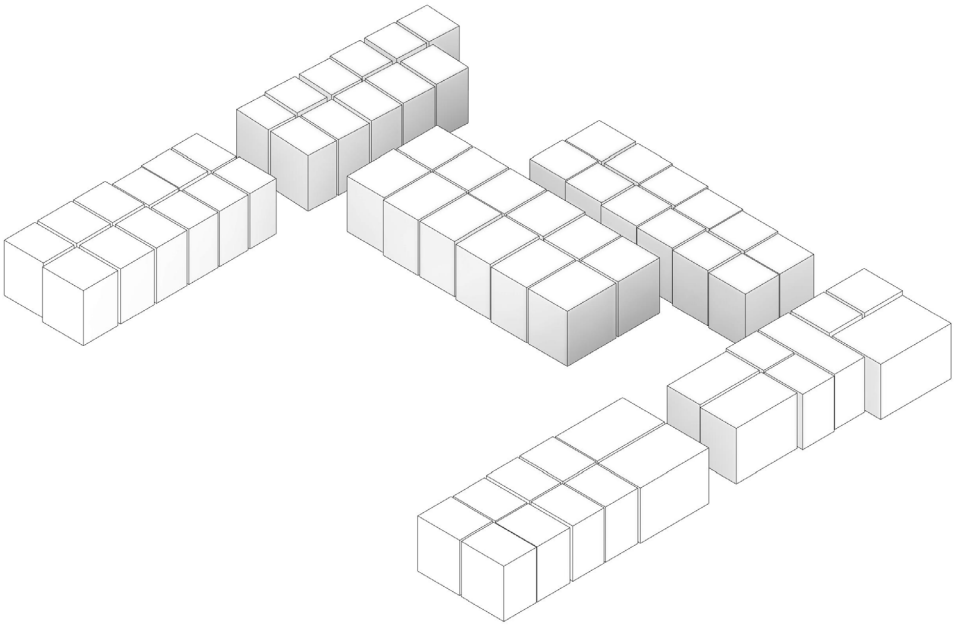
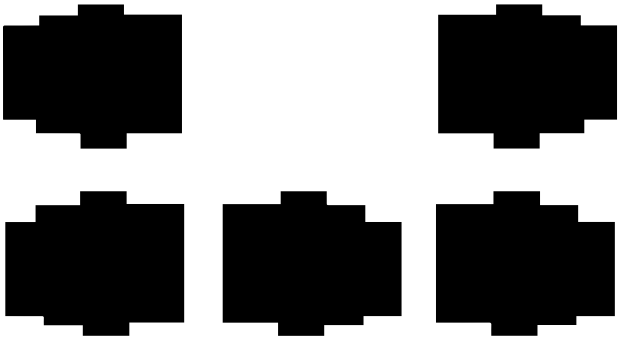
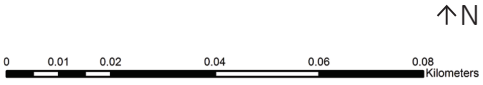


18 Arabsa 1

Housing type	Condominium 40/60
Area (Ha)	5.6
No. of Blocks	2
No. of floors	11 and 13
No. of dwelling units	610
NRD	109
BAR (%)	23.5

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence & High-Density Mixed Residence	Medium

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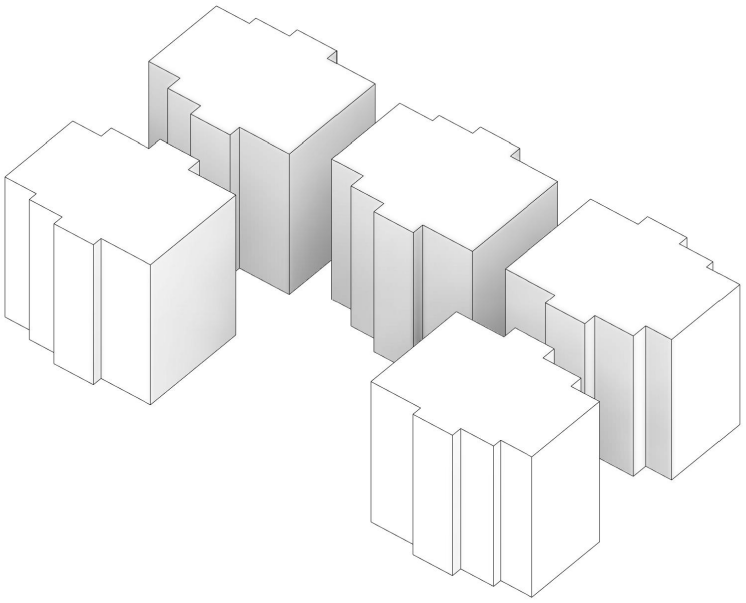
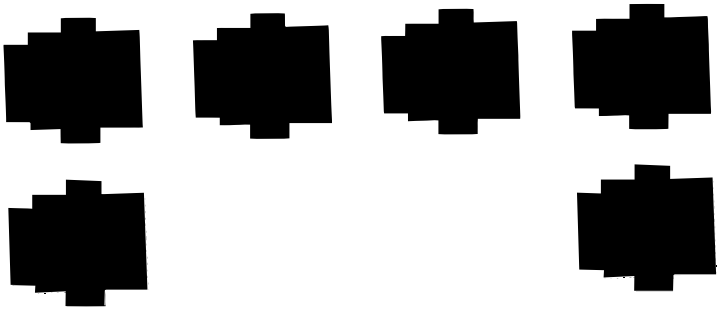
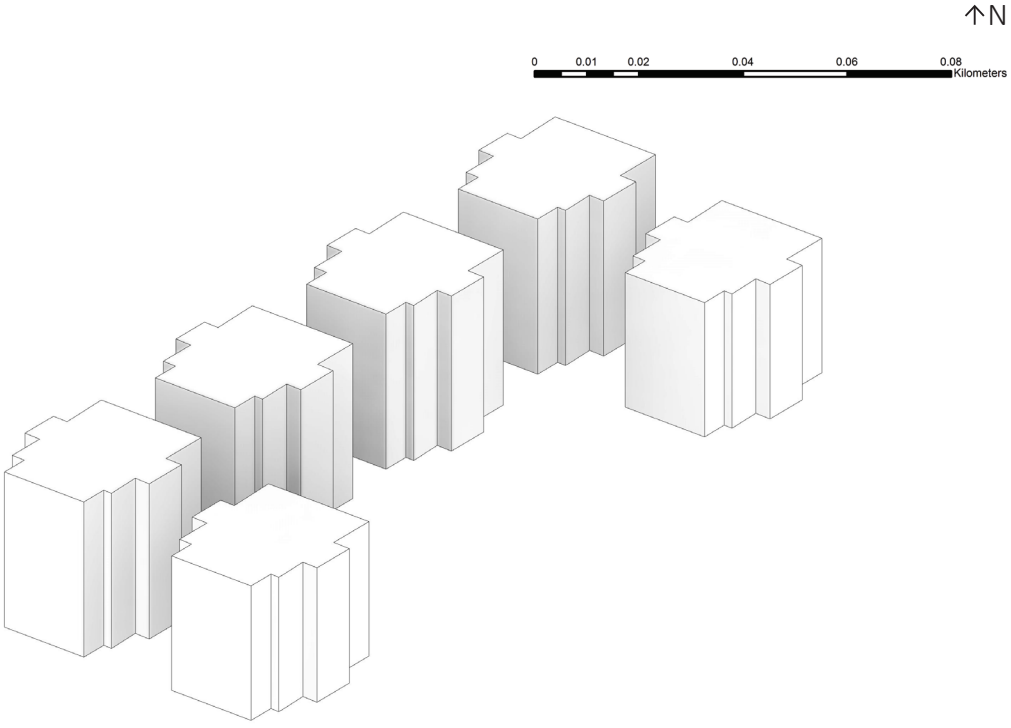


19 Arabsa 2

Housing type	Condominium 40/60
Area (Ha)	4.03
No. of Blocks	1
No. of floors	11 and 13
No. of dwelling units	740
NRD	184
BAR (%)	21.9

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
High-Density Mixed Residence	High

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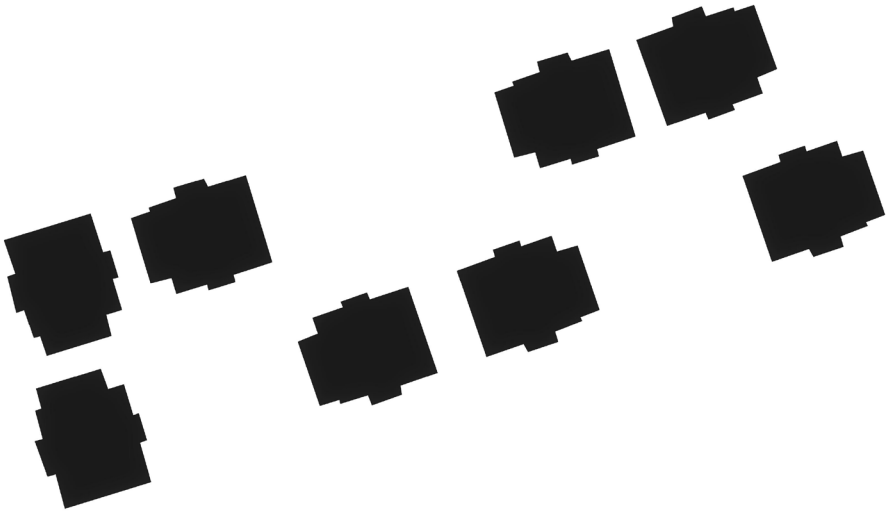
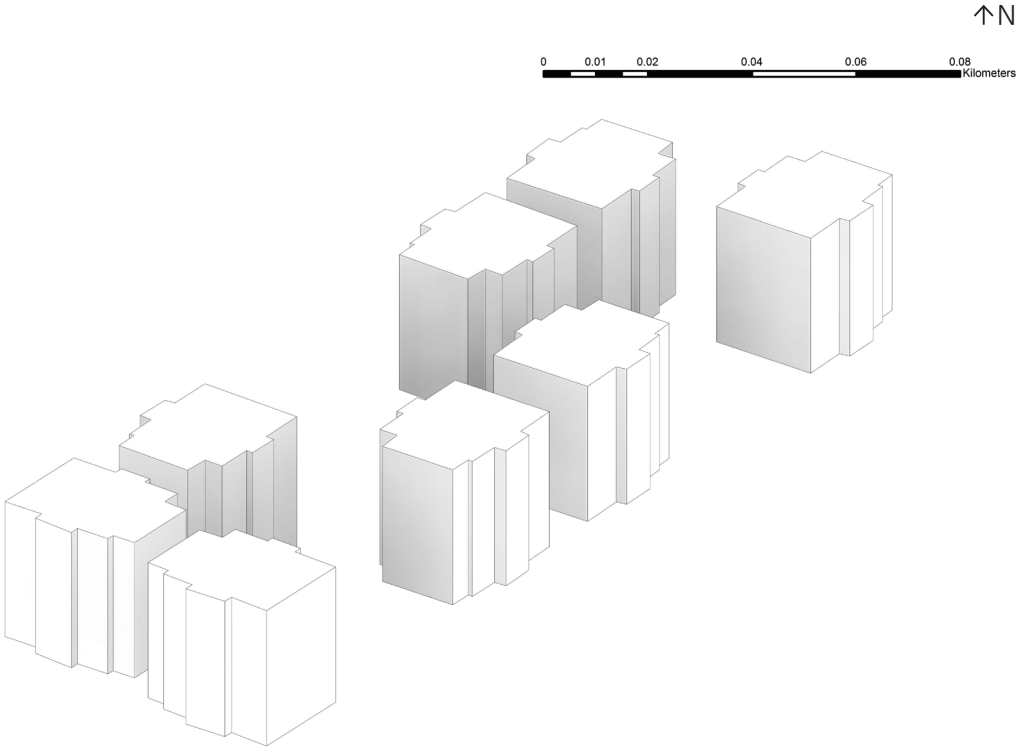
20 Gerji Emperial

Housing type	Condominium 40/60
Area (Ha)	4.2
No. of Blocks	1
No. of floors	14
No. of dwelling units	880
NRD	210
BAR (%)	26

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	High

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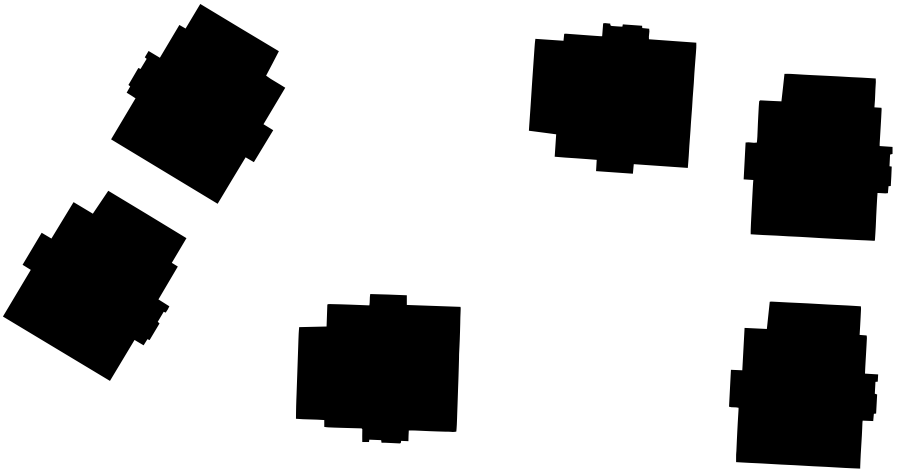
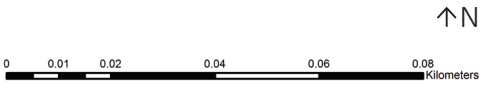
21 Ehile Nigd site

Housing type	Condominium 40/60
Area (Ha)	3.43
No. of Blocks	2
No. of floors	10
No. of dwelling units	600
NRD	175
BAR (%)	32.6

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Medium-Density Mixed Residence	High

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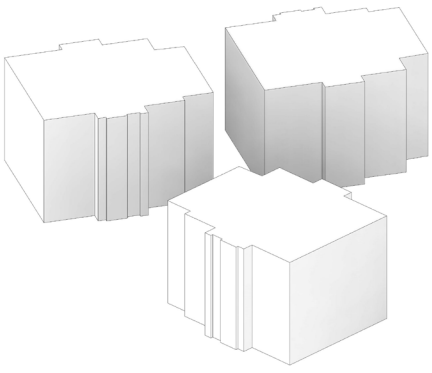
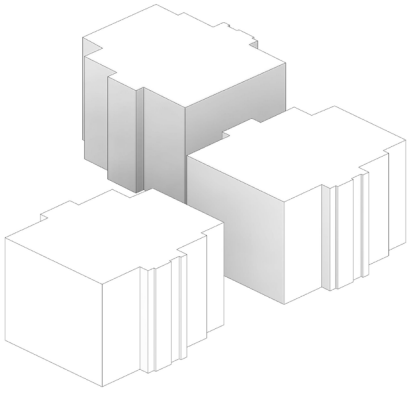
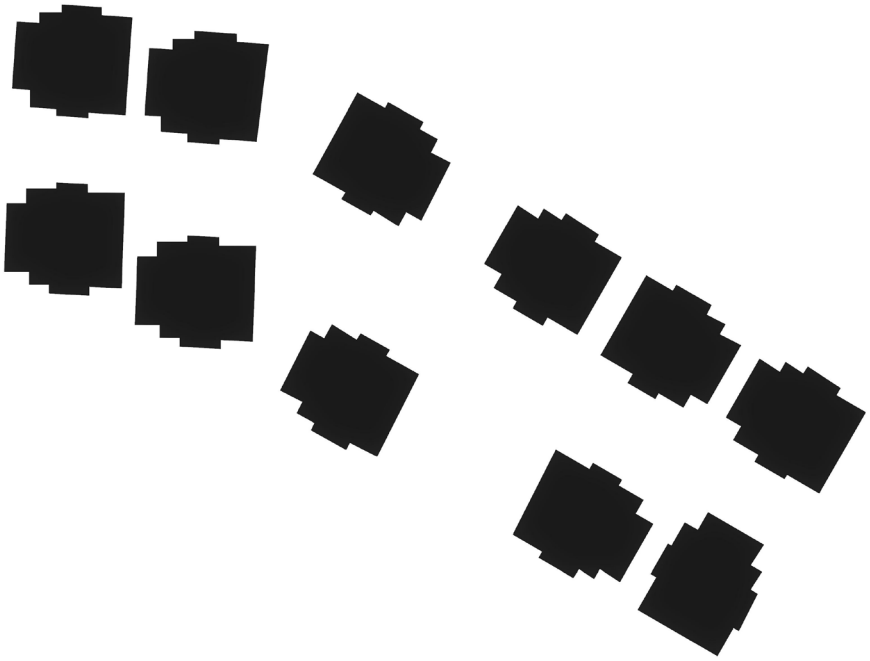




22 Tourist site

Housing type	Condominium 40/60
Area (Ha)	4.57
No. of Blocks	2
No. of floors	16
No. of dwelling units	1936
NRD	424
BAR (%)	40

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Medium-Density Mixed Residence	High



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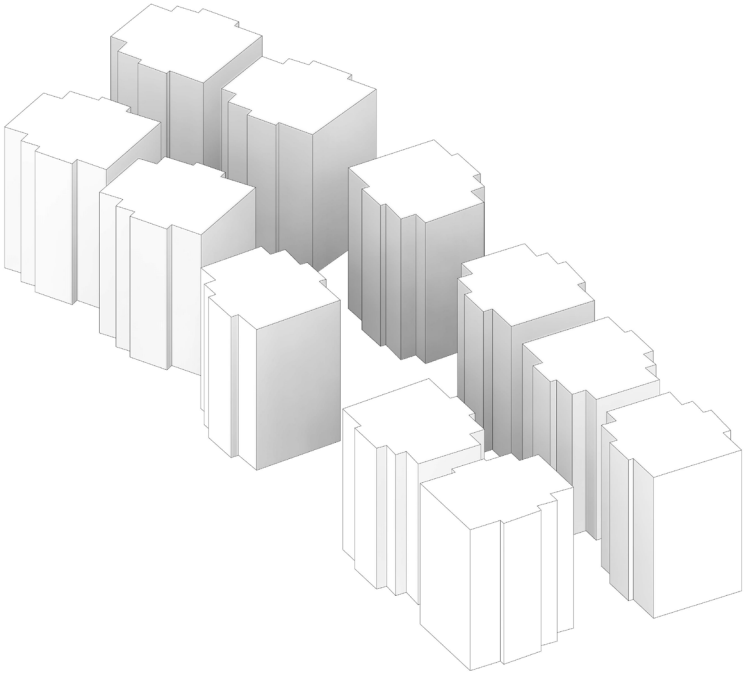
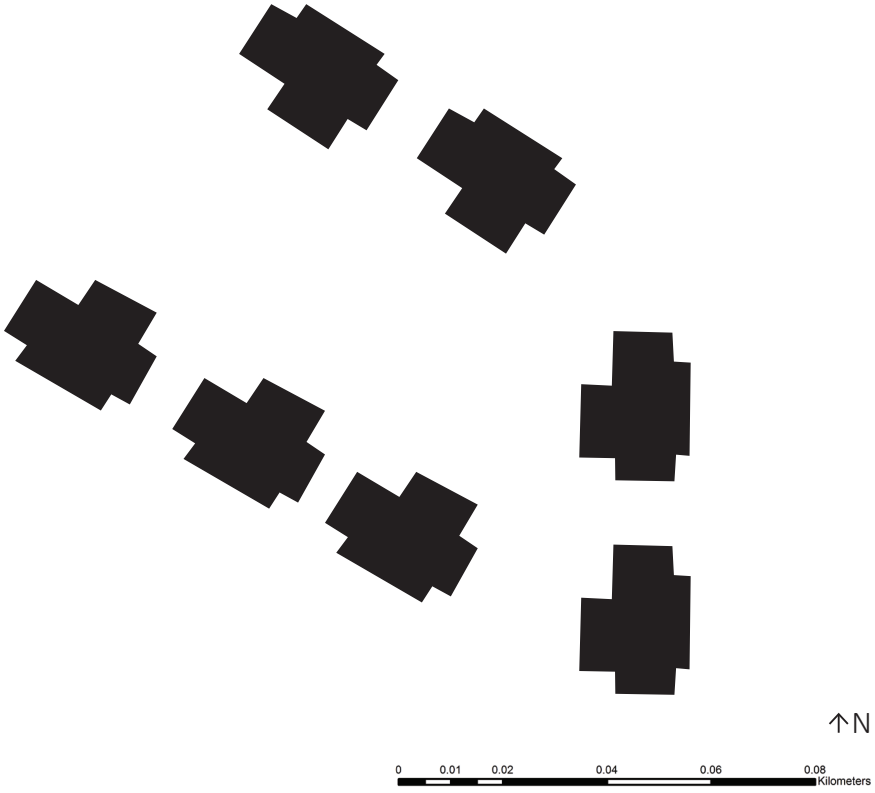


23 Beshale

Housing type	Condominium 40/60
Area (Ha)	3.02
No. of Blocks	1
No. of floors	8
No. of dwelling units	224
NRD	74
BAR (%)	56

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
High-Density Mixed Residence	Medium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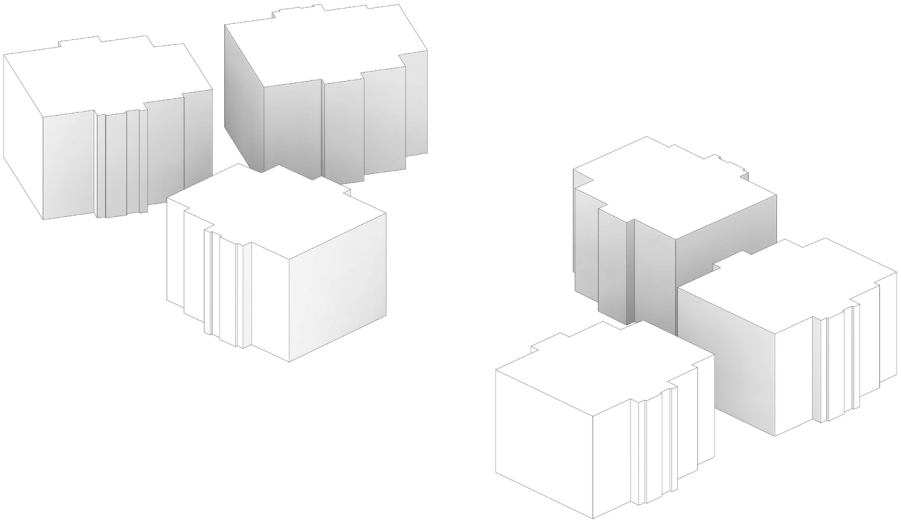
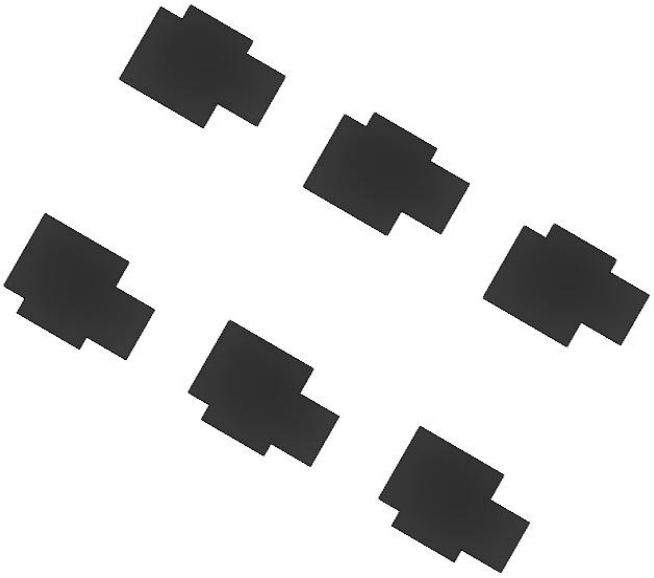
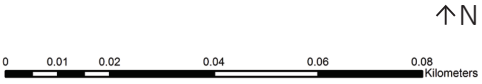


24 Beshale 1

Housing type	Condominium 40/60
Area (Ha)	2.05
No. of Blocks	1
No. of floors	10
No. of dwelling units	192
NRD	94
BAR (%)	22

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	Medium

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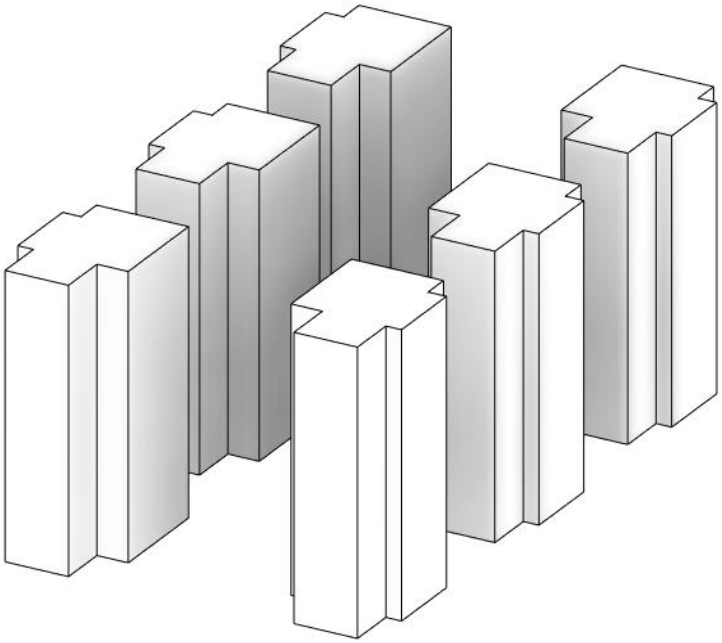
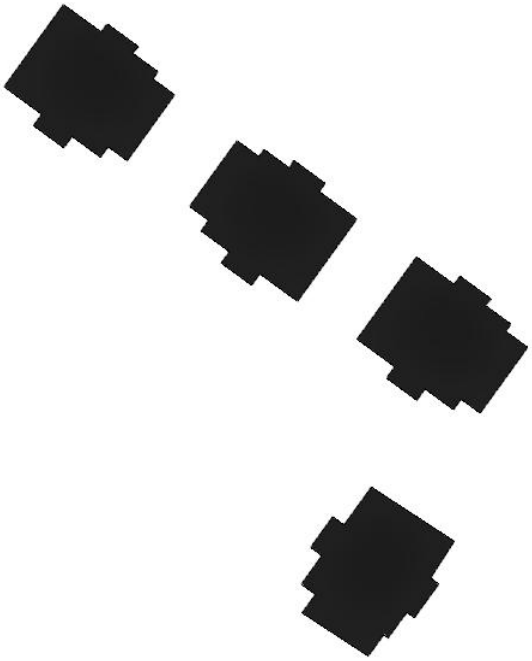
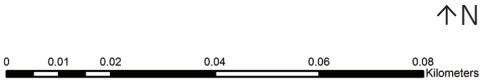


25 Beshale 2

Housing type	Condominium 40/60
Area (Ha)	5.1
No. of Blocks	1
No. of floors	15
No. of dwelling units	520
NRD	102
BAR (%)	11.2

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	Medium

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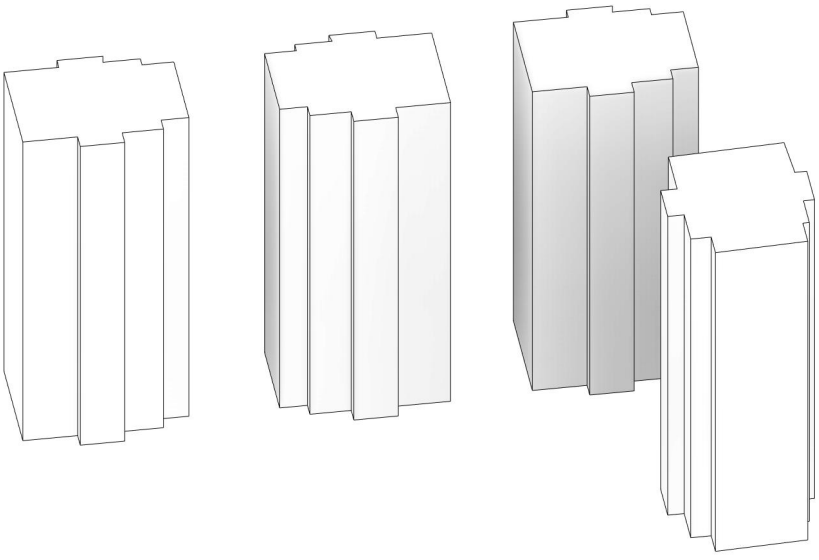
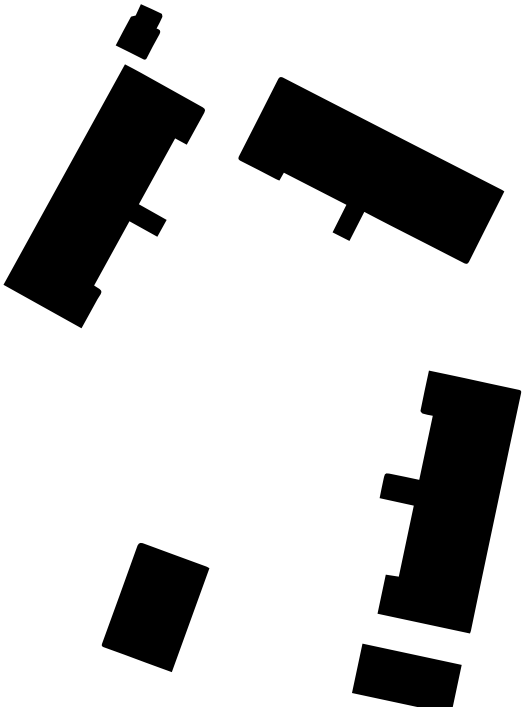
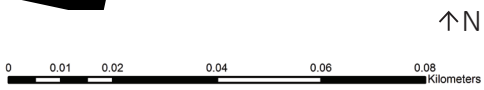


26 34 Meda

Housing type	Condominium 20/80
Area (Ha)	0.62
No. of Blocks	1
No. of floors	6
No. of dwelling units	72
NRD	116
BAR (%)	16.6

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Medium-Density Mixed Residence & High-Density Mixed Residence	Medium

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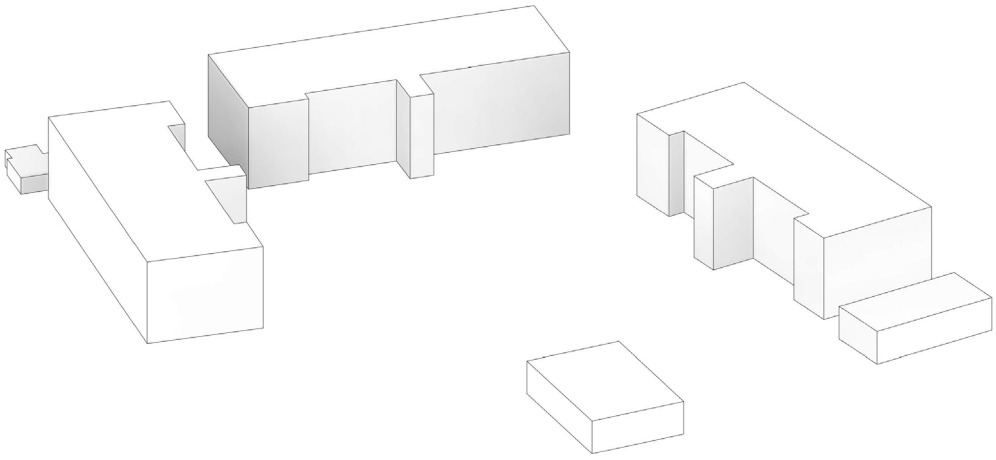
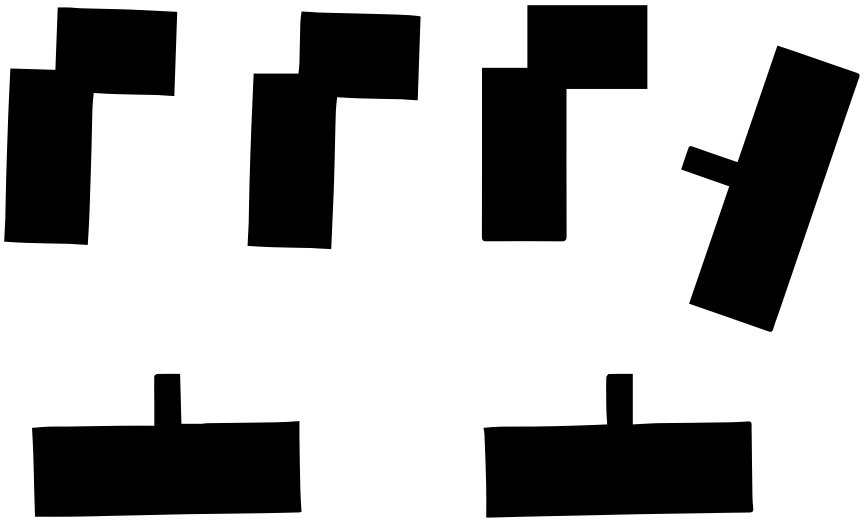
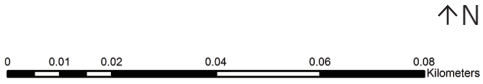


27 Gotera

Housing type	Condominium 20/80
Area (Ha)	0.64
No. of Blocks	1
No. of floors	5
No. of dwelling units	159
NRD	248
BAR (%)	25

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Medium-Density Mixed Residence	High

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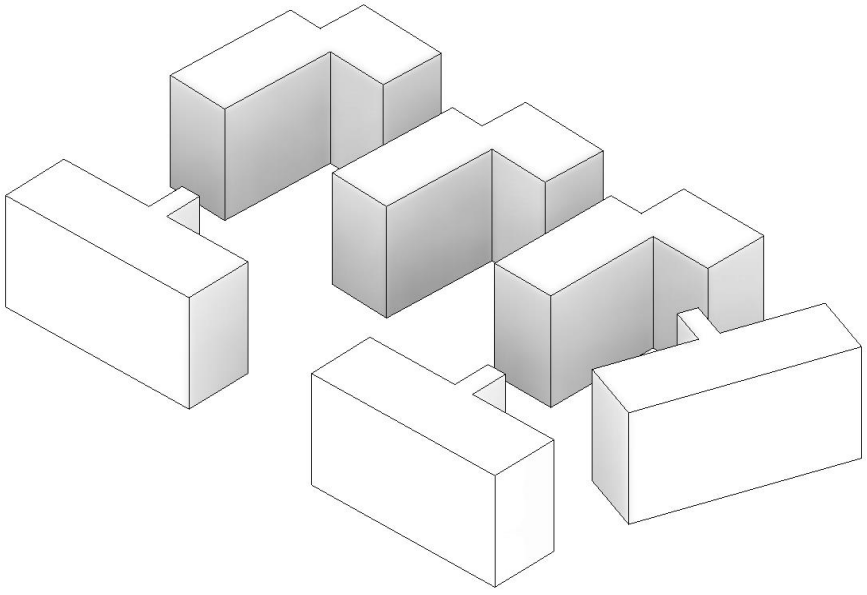
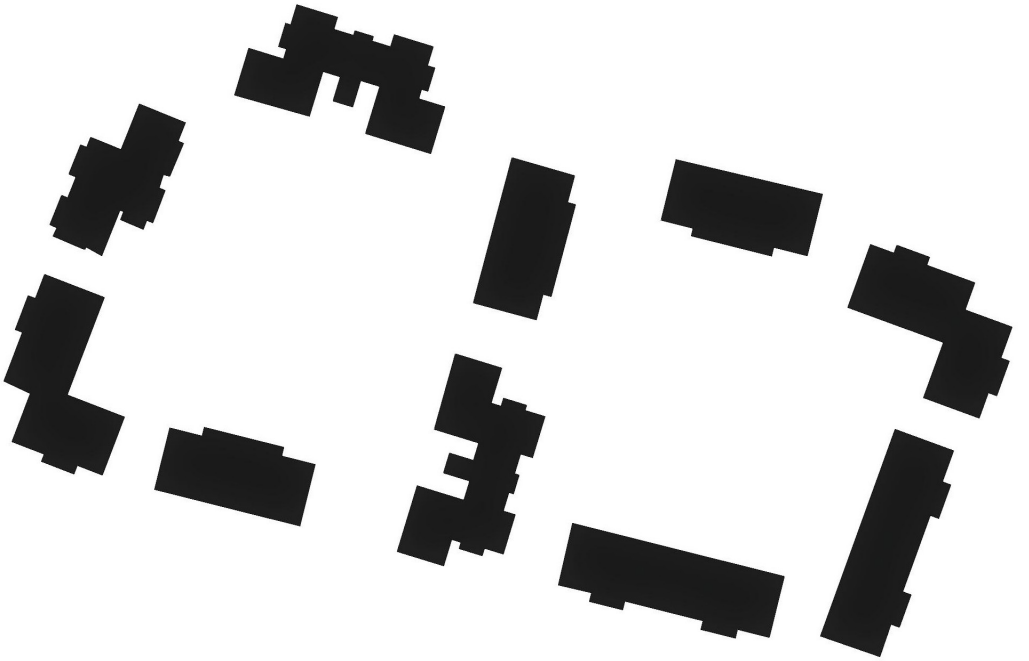


28 Yeka Ababdo

Housing type	Condominium 20/80
Area (Ha)	1.675
No. of Blocks	1
No. of floors	5
No. of dwelling units	188
NRD	112
BAR (%)	18.3

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	Medium



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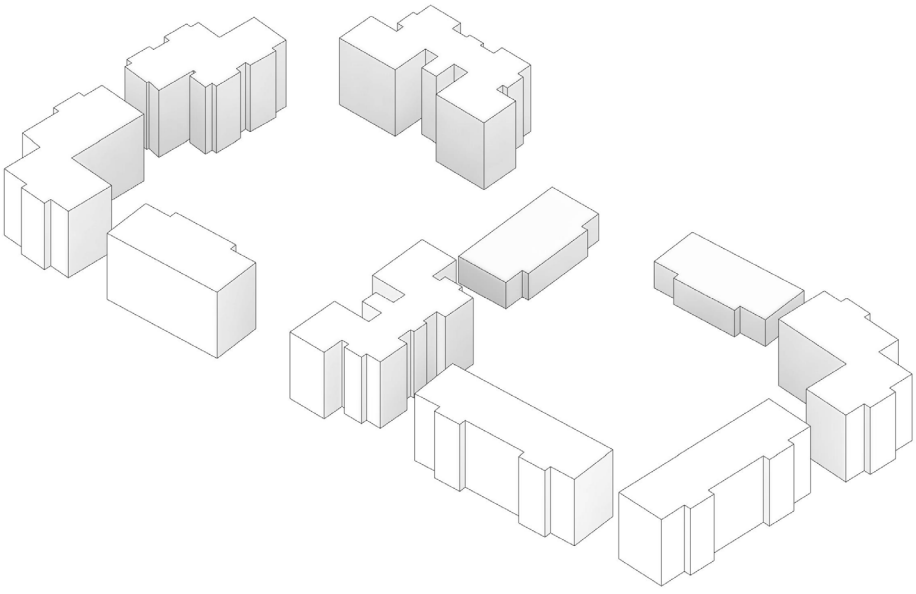
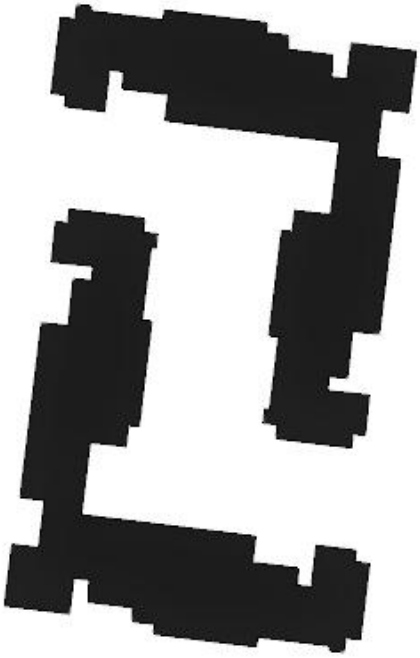


29 Lideta

Housing type	Condominium 20/80
Area (Ha)	0.63
No. of Blocks	1
No. of floors	8
No. of dwelling units	176
NRD	278
BAR (%)	21.85

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
High-Density Mixed Residence	High



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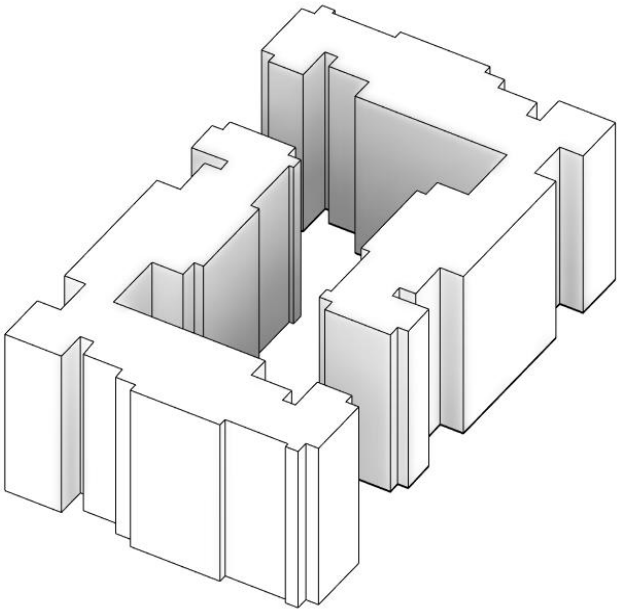
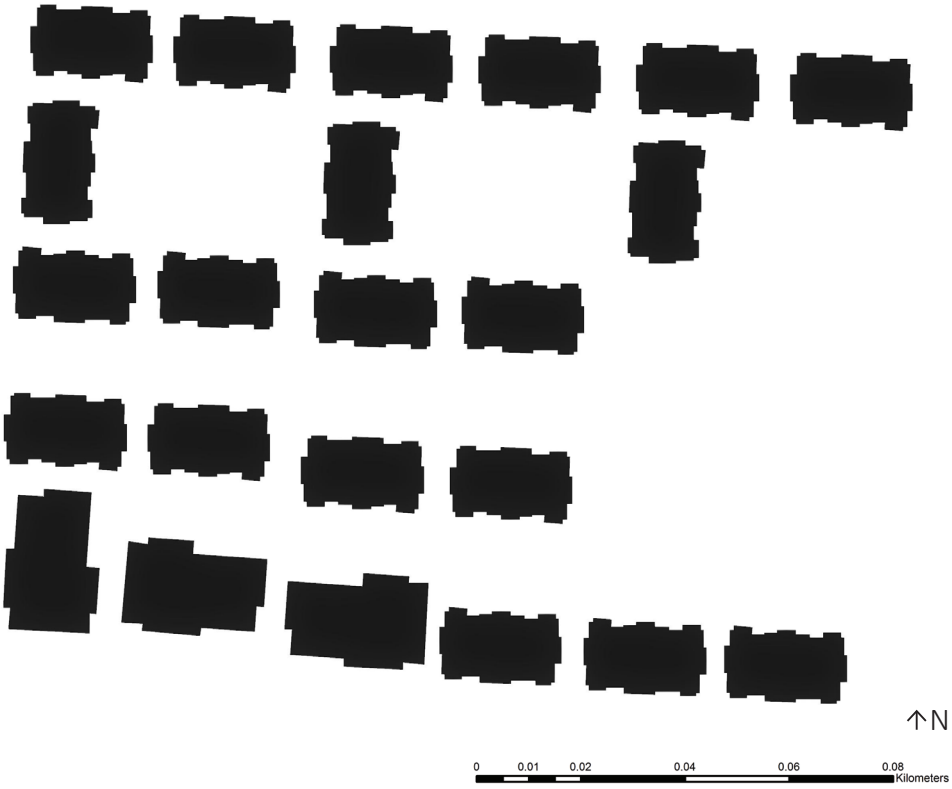


30 Sunshine

Housing type	Real etate
Area (Ha)	4.2
No. of Blocks	1
No. of floors	5
No. of dwelling units	835
NRD	199
BAR (%)	29.07

Land use category based on the Structural Plan (SP)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence & High-Density Mixed Residence	High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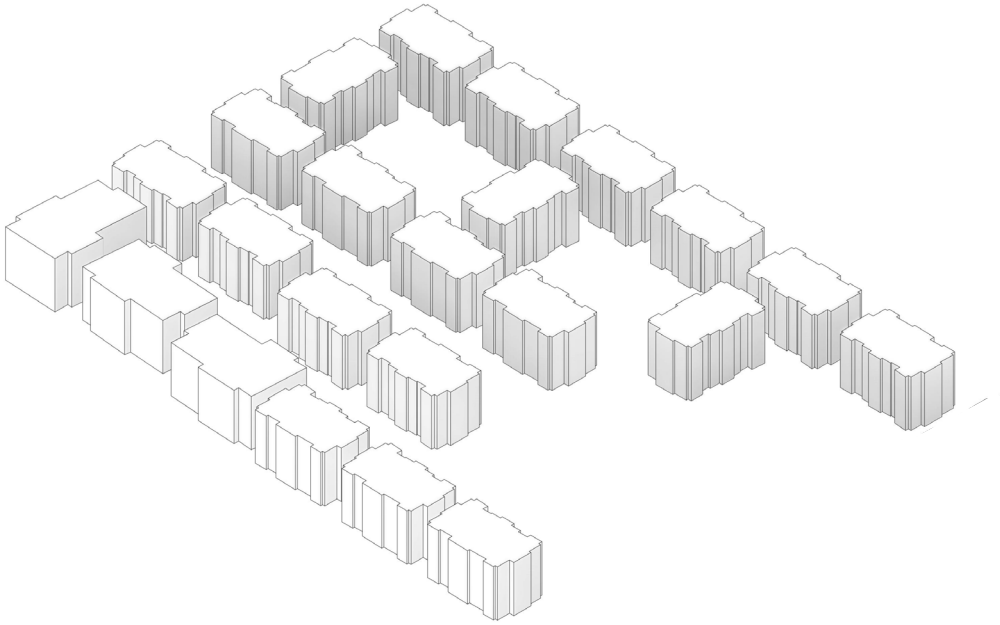


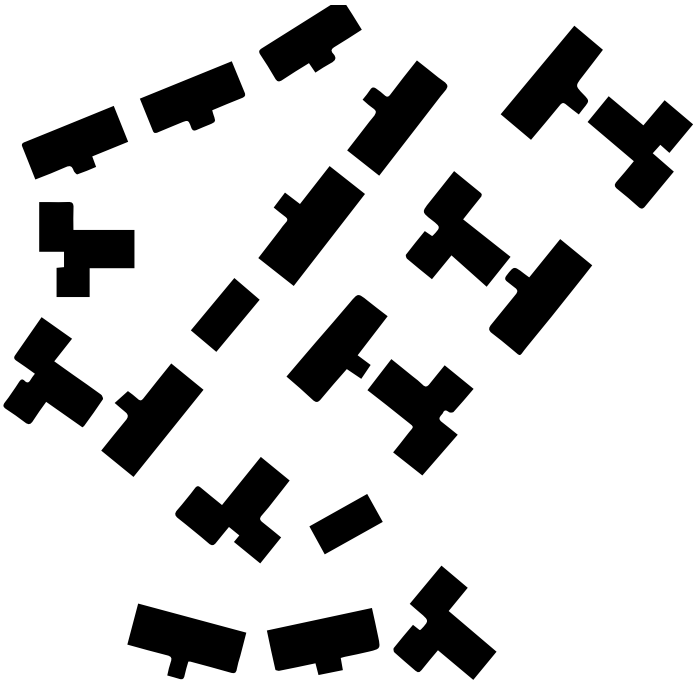
Section II Gross Residential Density

Location map of Gross Residential Study Sites

01 Gotera

Housing type	Condominium 20/80
Area (Ha)	17.08
No. of Blocks	15
No. of floors	5
No. of dwelling units	2204
GRD	129
BAR (%)	13.9

Land use category based on SP	Expected minimum GRD on SP	How less/more is GRD compared with the minimum SP`s GRD requirement (%)	Level of NRD based on UN Habitat`s NRD standard
Medium-Density Mixed Residence	100	+29	High



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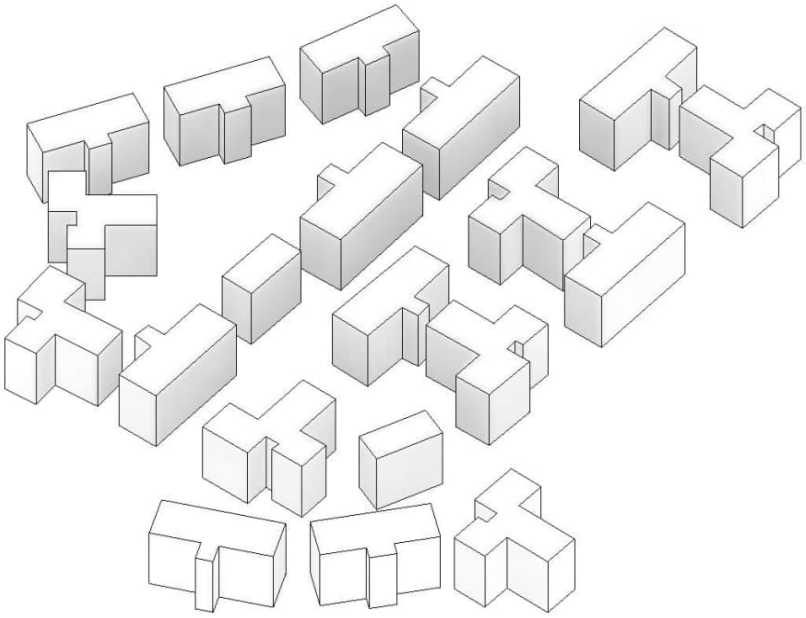
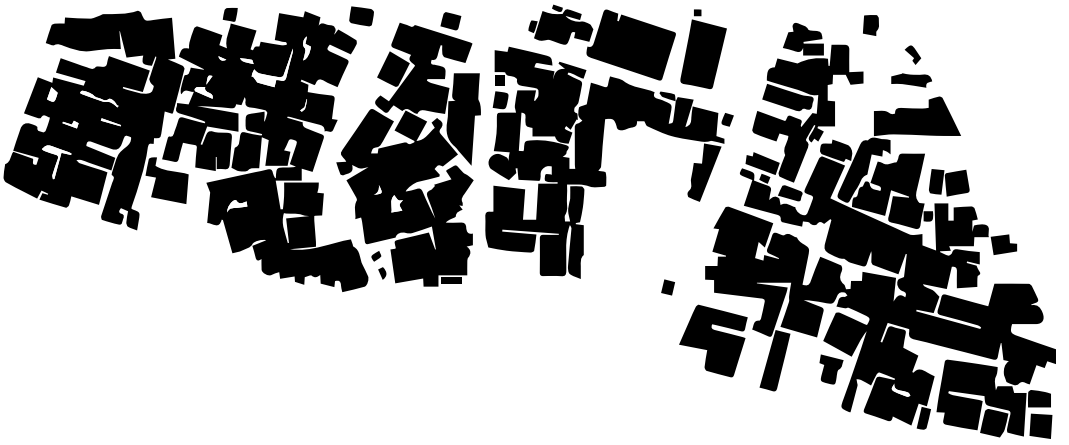


02 Coca Cola Sefer

Housing type	Kebele Housing
Area (Ha)	12.5
No. of Blocks	8
No. of floors	1
No. of dwelling units	1036
GRD	83
BAR (%)	64.8

Land use category based on SP	Expected minimum GRD on SP	How less/more is GRD compared with the minimum SP`s GRD requirement (%)	Level of NRD based on UN Habitat`s NRD standard
High-Density Mixed Residence	150	-45	High



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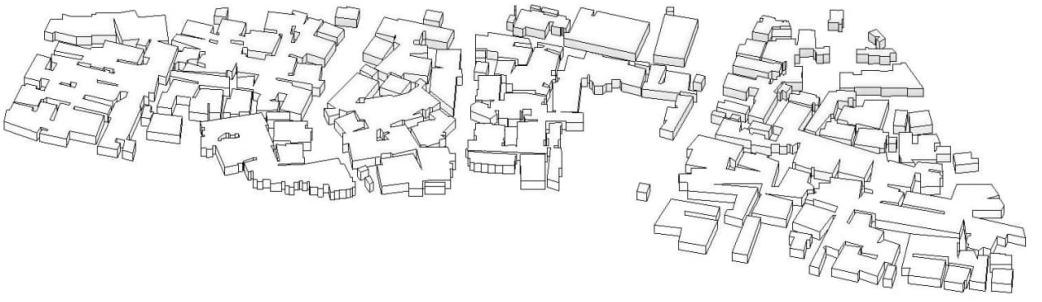
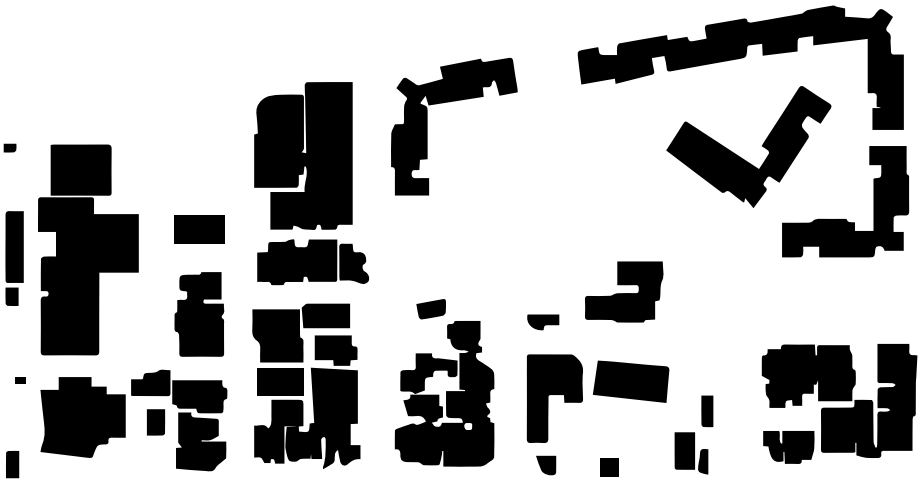
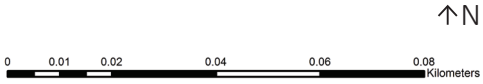


03 Lideta

Housing type	Condominium 20/80
Area (Ha)	34.2
No. of Blocks	7
No. of floors	5 to 13
No. of dwelling units	2382
GRD	70
BAR (%)	26

Land use category based on SP	Expected minimum GRD on SP	How less/more is GRD compared with the minimum SP`s GRD requirement (%)	Level of NRD based on UN Habitat`s NRD standard
High-Density Mixed Residence	150	-54	High

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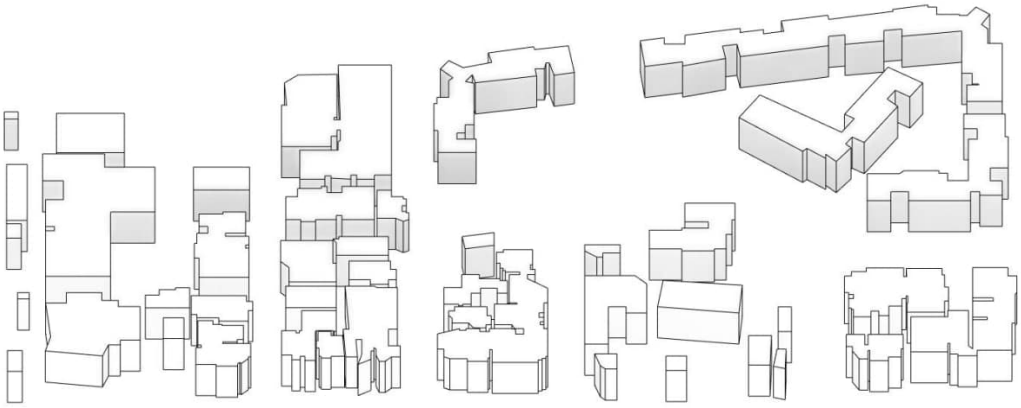
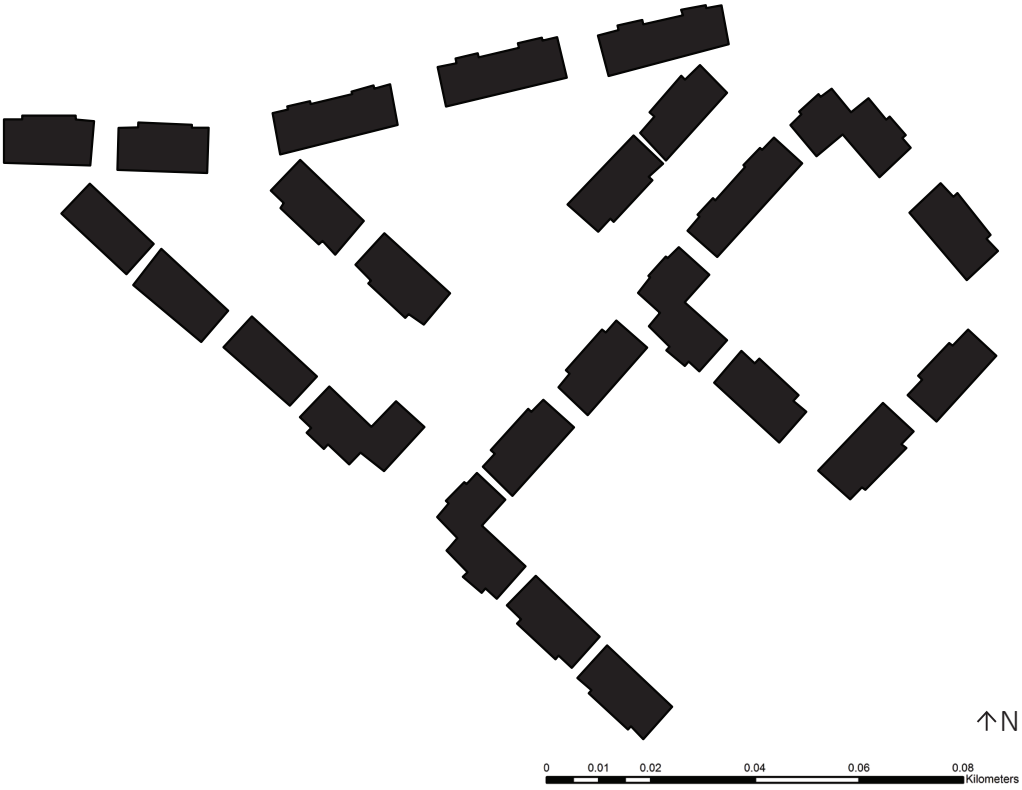


04 Jemo 3

Housing type	Condominium 20/80
Area (Ha)	19.35
No. of Blocks	13
No. of floors	5
No. of dwelling units	2282
GRD	118
BAR (%)	17.2

Land use category based on SP	Expected minimum GRD on SP	How less/more is GRD compared with the minimum SP`s GRD requirement (%)	Level of NRD based on UN Habitat`s NRD standard
Low-Density Mixed Residence	50	+136	High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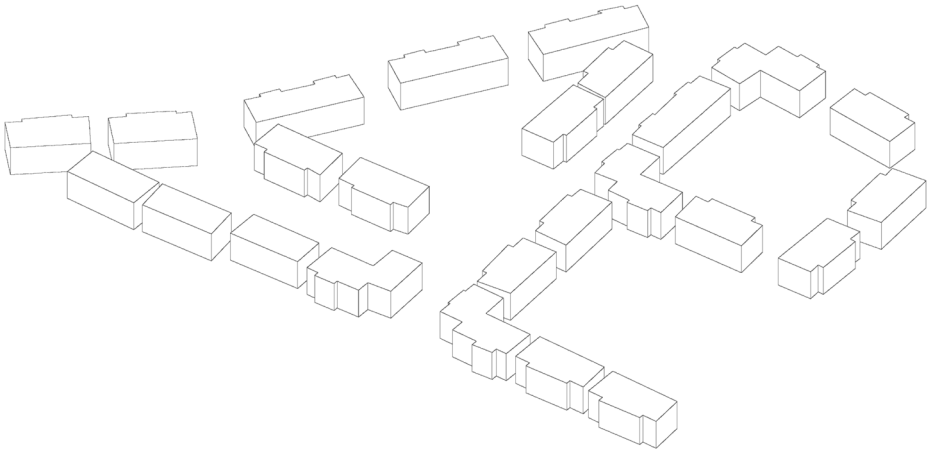


Section III Analysis and findings

This study was conducted in 32 different sites located within Addis Ababa. The study sites are located across eight sub-cities (* The study used the former 10 sub-cities boundary sub-division) of Addis Ababa namely; Lideta, Kirkos, Gulele, Yeka, Nifas Silk Lafto, Kolfe Keranio, Akaky Kality, and Bole. The housing typologies included in the study are condominiums, cooperative housings, real estates, kebele housings, upgraded kebele housing units, informally built housings, privately developed formal housings, and regularized informal housings. Net residential density was studied for 30 of the study sites. Gross residential density was researched for 4 sites, namely; Lideta, Gotera, Jemo 3 condominiums, and the co ca-cola site with an over-lap in Lideta and Gotera condominiums.

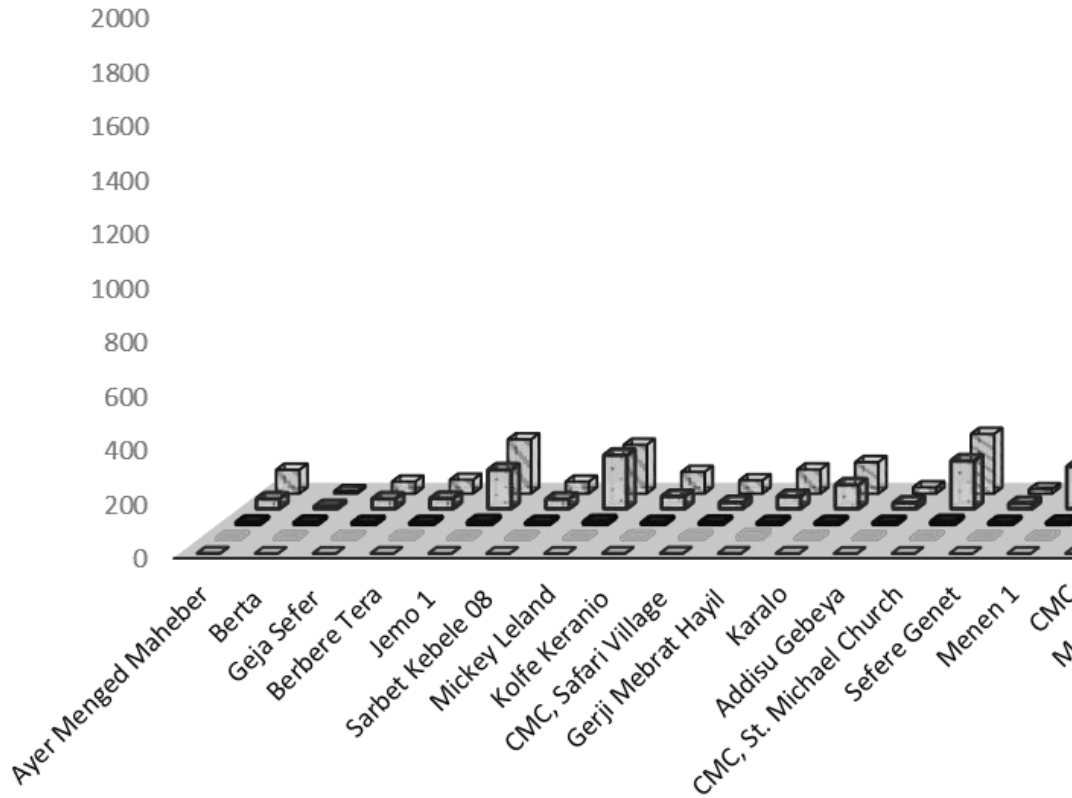
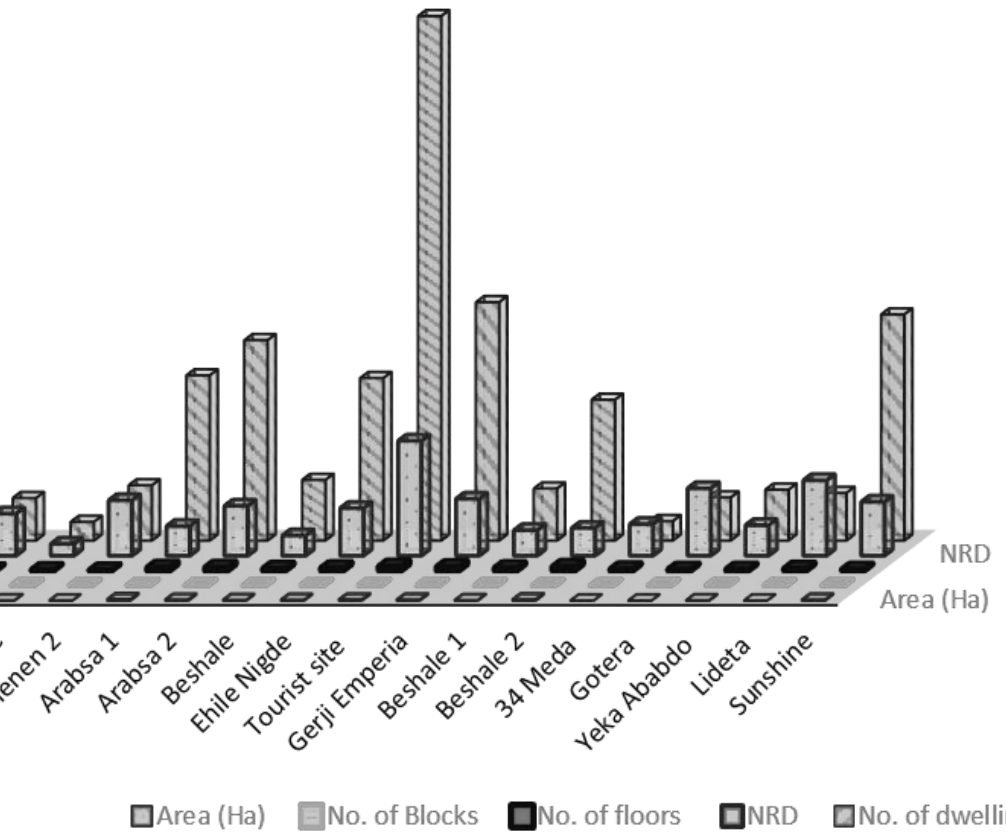


Figure 1 Data record for Net Residential Density study

The findings of this study are presented and discussed in two parts. The first part deals with Net residential density, whereas, the second part is about gross residential density.

I.Net Residential Density

The main parameters used to assess the level of residential density across the study sites are types of the residential unit, area, number of blocks, number of floors, number of dwelling units, net residential density, and built-up area ratio. Figure 1 shows the measure of all parameters studied to understand net residential density across different case sites.



Fifteen of the study sites are condominium sites, of which seven of them are built under the 20/80 and eight of them are 40/60 condominiums. The seven 20/80 condominium sites are Yeka Abdo, Lideta, Gotera, Jemo1, Jemo 3, Keranio, and 34 Meda Condominium, whereas the rest eight sites (3 sites from Beshale, 1 site from Emperial, 1 site from Tourist site, 1 site from Ehil Nigd and 2 sites from Arabsa) are 40/60 condominiums.

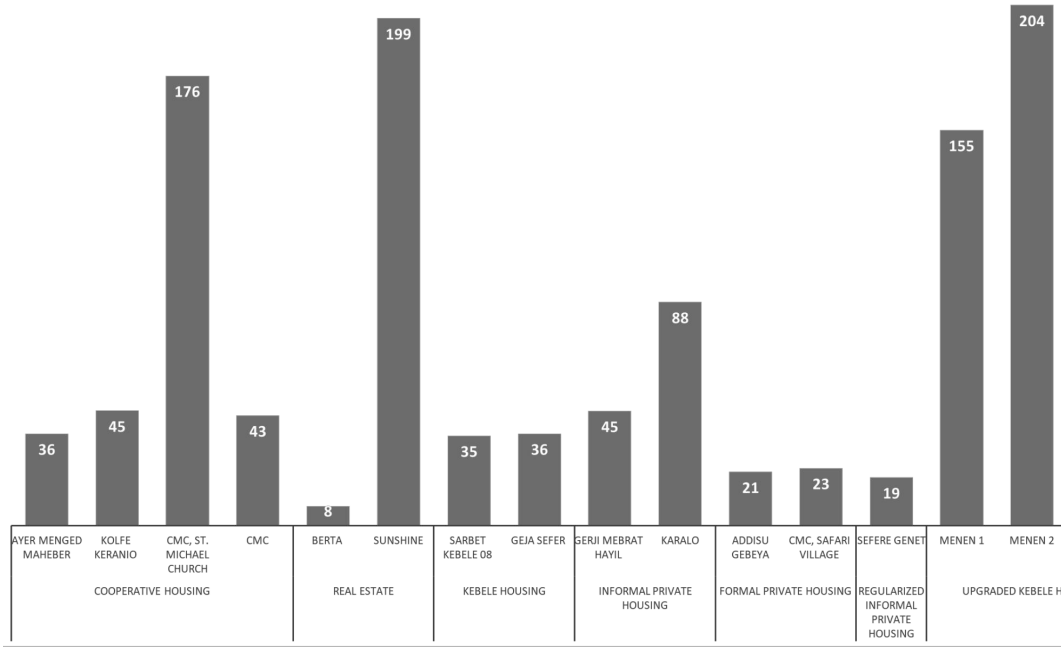
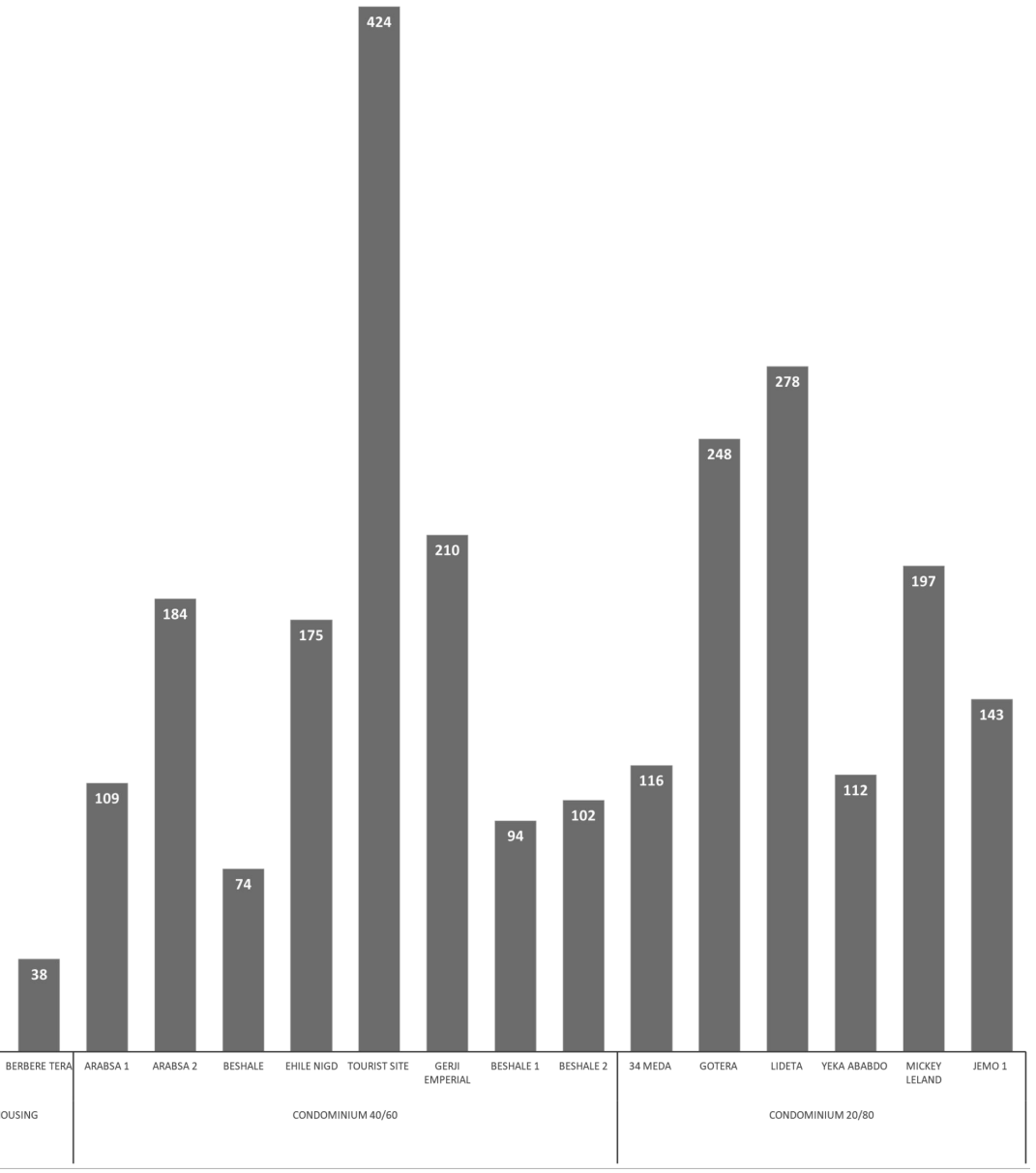


Figure 2:Net Residential Density sized across different residential units

Figure 2 shows the measure of net residential density across different residential types.



The study revealed that the net residential density in condominium sites is higher than the other sites. Moreover, the study revealed that 20/80, 40/60 condominiums, Real Estates, and Cooperative Housings are the four housing typologies hosting the largest mean residential densities respectively. One can see from the above figure that the study sites exhibited diverging net residential density ranging from the smallest 8 Du/Ha recorded in Berta real estate to the highest 424 DU/Ha recorded in the Tourist site.

Compared with the UN Habitat`s residential density standard, six out of ten study sites showed net medium to very low net residential density. Twelve of the study sites, namely; Jemo 1, Mickey Leland, CMC, St. Michel Church, Menen 1, Menen 2, Arabsa 2, Ehile Nigd, Tourist site, Gerji Emperia, Gotera, Lideta, and Sunshine exhibited high net residential density. The rest 10 states, namely; Kolfe Keranio, Gerji Mebrat Hayil, Karalo, CMC, Arabsa 1, Beshale, Beshale 1, Beshale 2, 34 Meda and Yeka Ababdo showed medium density. On the contrary, Ayer Menged Maheber, Geja Sefer , Berbere Tera, Sarbet Kebele 08, CMC, Safari Village, Addisu Gebeya, and Sefere Genet are the sites that showed low net residential density. Table 1 shows the UN Habitat`s net and gross residential density standards.

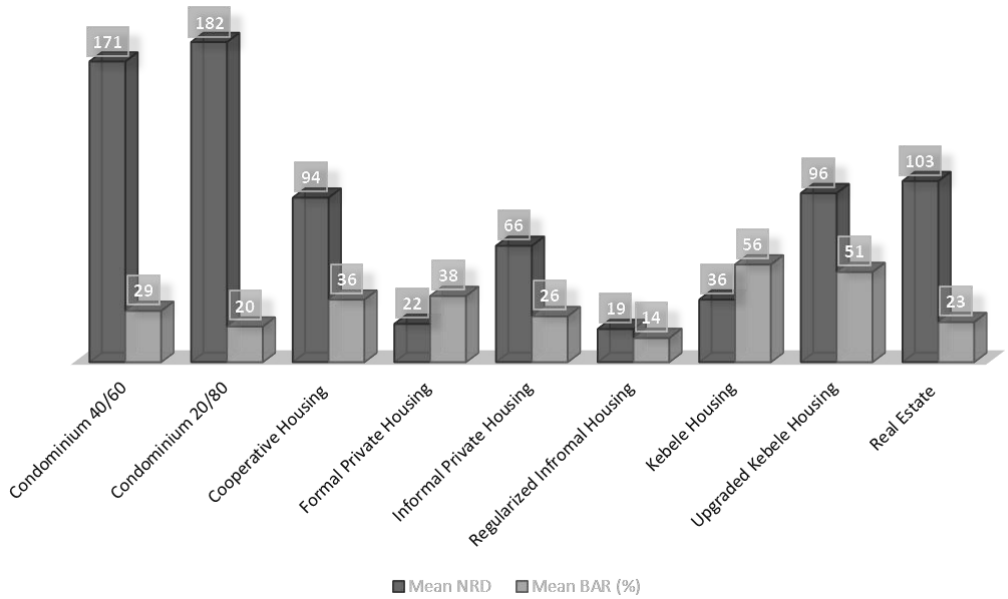


Figure 3 Mean net residential density vs. mean BAR for various residence types

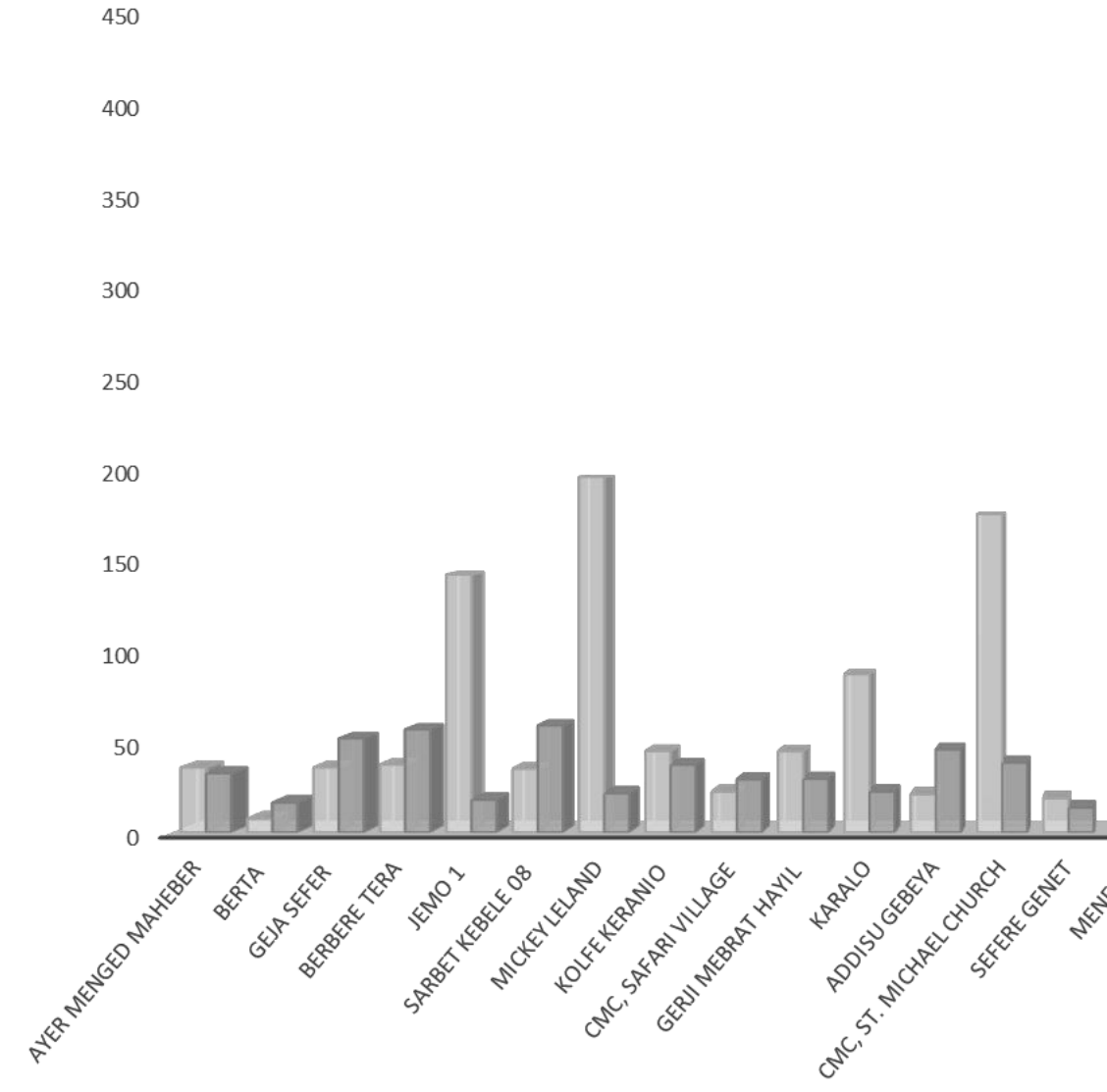
Density level	Net Residential Density (DU/Ha)	Gross Residential Density (DU/Ha)
Very low	Below 15	Below 7
Low	15-40	7-18
Medium	40-120	18-54
High	120-500	54-225
Very High	Above 500	Above 225

Table 1 UN Habitat`s net and gross residential density standard

Moreover, in terms of mean net residential density, the 20/80 condominium scheme could achieve the highest mean residential density which is 182 D.U/Ha net residential density on only one-fifth of the total area of sites studied under the 20/80 scheme. This proportion is equivalent to a 20% Build-up area ratio (BAR). On the contrary, even if the 40/60 condominium scheme could achieve the second-highest mean residential density level, which is 171 D.U/Ha Net residential density, It required 29% BAR to accommodate the above-stated number of households. The study also revealed that the Kebele housings and formal private housings are less dense and they used, at least, more than 35% of their given land for dwelling units` construction which constrained the amount of soft space that should be availed for urban dwellers. In this regard, the Kebele Housings had to use 56% of their land to accommodate a little more than one-fifth of an average residential density the 20/80 condominiums could accommodate. Figure 3 shows the mean net residential density vs. mean BAR for various housing types.

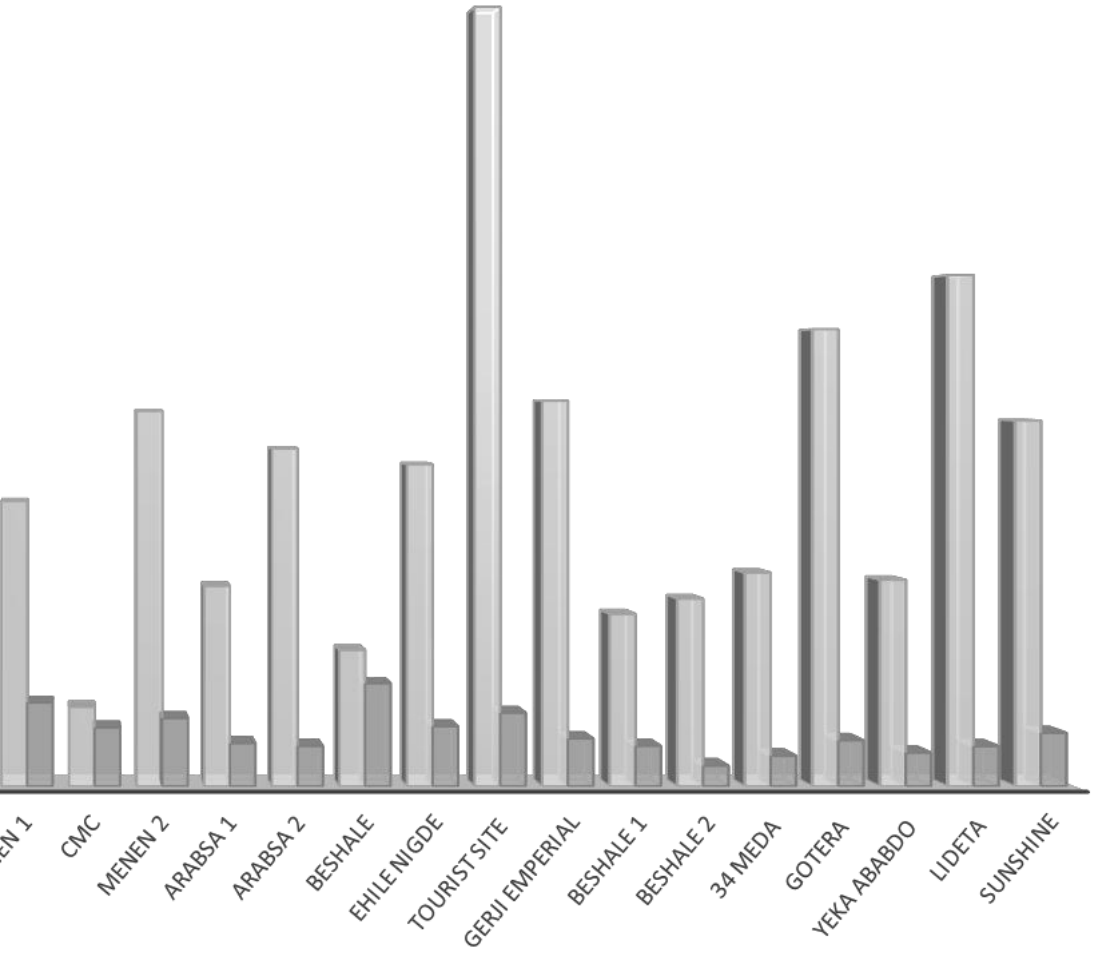
Net residential density and built-up area ratio are the two critical parameters clearly showing the density level of an area. Most particularly, Built-up plays a pivotal role by showing how much density is achieved against the measure of used land for building layouts and immediate facilities and services.

If one perceives net residential density alone excluding BAR, the study result shows that, with 424 dwelling units per hectare net residential density, the highest residential density is perceived in Tourist site followed by Lideta, Gotera, and Gerji Emperial condominiums respectively which depicts that condominium could achieve a higher level of density compared with other forms of housing. On the contrary, the smallest residential density among the study sites is recorded in Berta Real Estate with about 8 d.u/Ha net residential density. Figure 4 shows the level of NRD along with BAR in the study sites selected for the NRD study.



	Ayer Menged Maheber	Berta	Geja Sefer	Berbere Tera	Jemo 1	Sarbet Kebele 08	Mickey Leland	Kolfe Keranio	CMC, Safari Village	Gerji Mebrat Hayil	Karalo	Addisu Gebeya	CMC, St. Michael Church	Sefere Genet	Men
NRD	36	8	36	38	143	35	197	45	23	45	88	21	176	19	1
BAR (%)	32.7	16.5	52	57	18	59.2	21.6	37.4	29.4	29.6	22.6	45.9	38.6	13.7	45

Figure 4 NRD along with BAR in case sites



en 1	CMC	Menen 2	Arabsa 1	Arabsa 2	Beshale	Ehile Nigde	Tourist site	Gerji Emperial	Beshale 1	Beshale 2	34 Meda	Gotera	Yeka Ababdo	Lideta	Sunshine
55	43	204	109	184	74	175	424	210	94	102	116	248	112	278	199
.6	32	37.1	23.5	21.9	56	32.6	40	26	22	11.2	16.6	25	18.3	21.85	29.07

BAR (%)

II.Gross Residential Density

Gross residential density is a proportion of the number of dwelling units in a given area and the total area of the site including services and facilities serving a larger community beyond immediate residents.

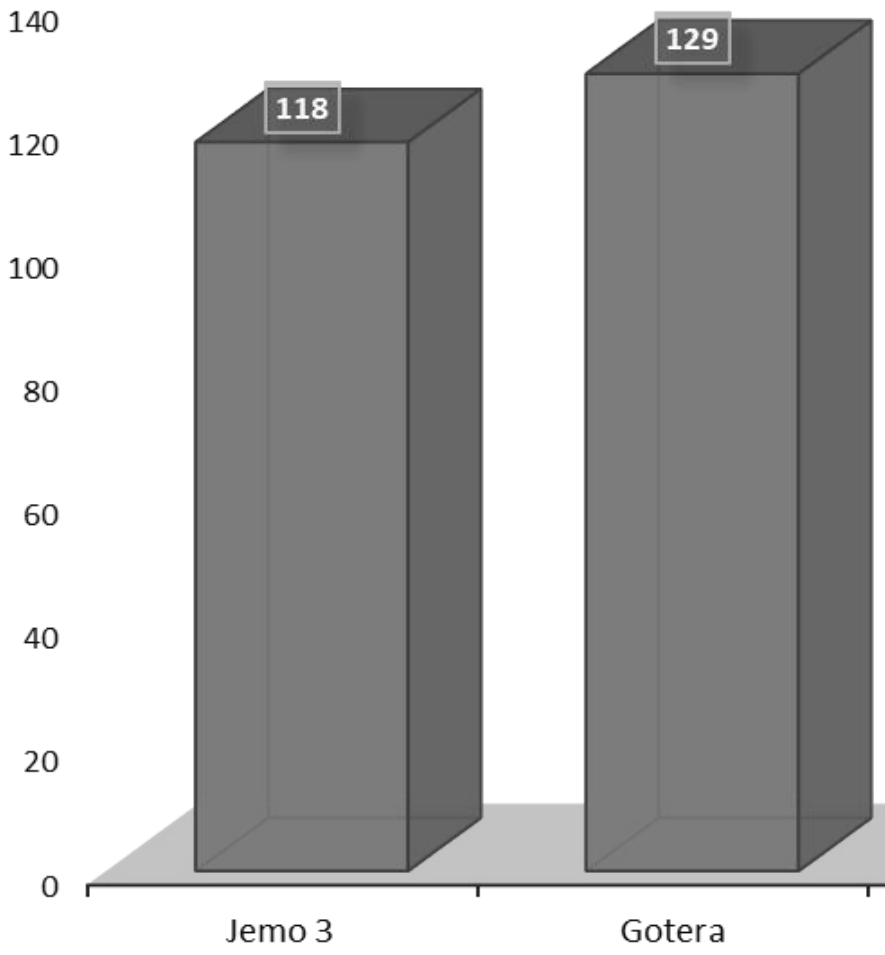
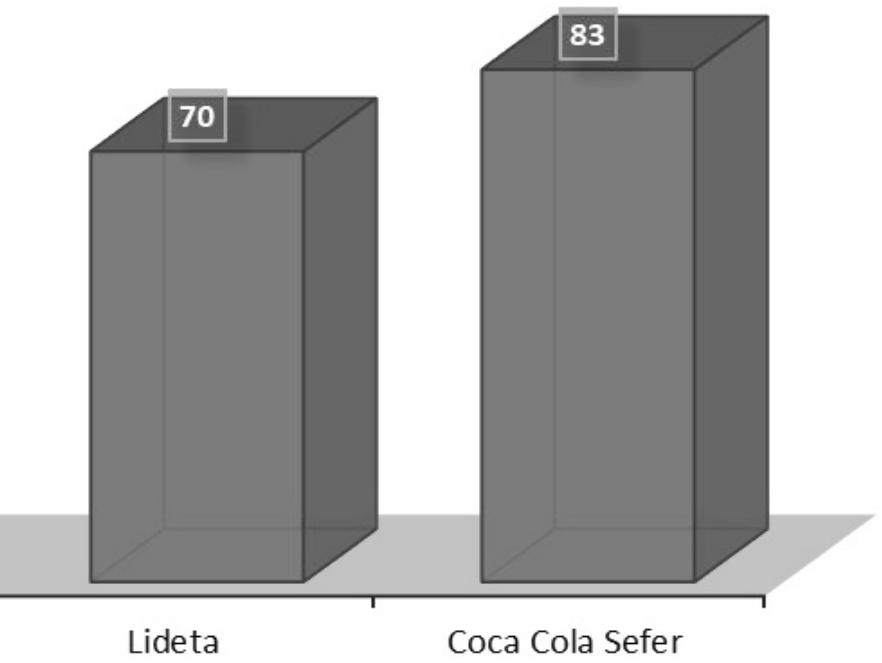


Figure 5 Gross Residential Density measures across case sites

Thus, gross residential density strives to understand residential density from a larger scale. The gross density across the four case sites ranges from the smallest 70 DU/Ha GRD in Lideta to the highest 129 DU/Ha in Gotera condominium. Figure 5 shows the gross residential density measure across the four case sites



The Addis Ababa city structural plan has a gross residential density standard it anticipates implementing during its plan period, 2017 to 2027. Accordingly, it proposed to achieve at least 50, 100, and 150 dwelling units per hectare in areas earmarked for low density mixed residence, medium density mixed residence, and high density mixed residence respectively.

When the recorded gross density in the study sites is compared against the gross density requirement of the structural plan, fourteen sites scored less than the minimum density threshold expected.

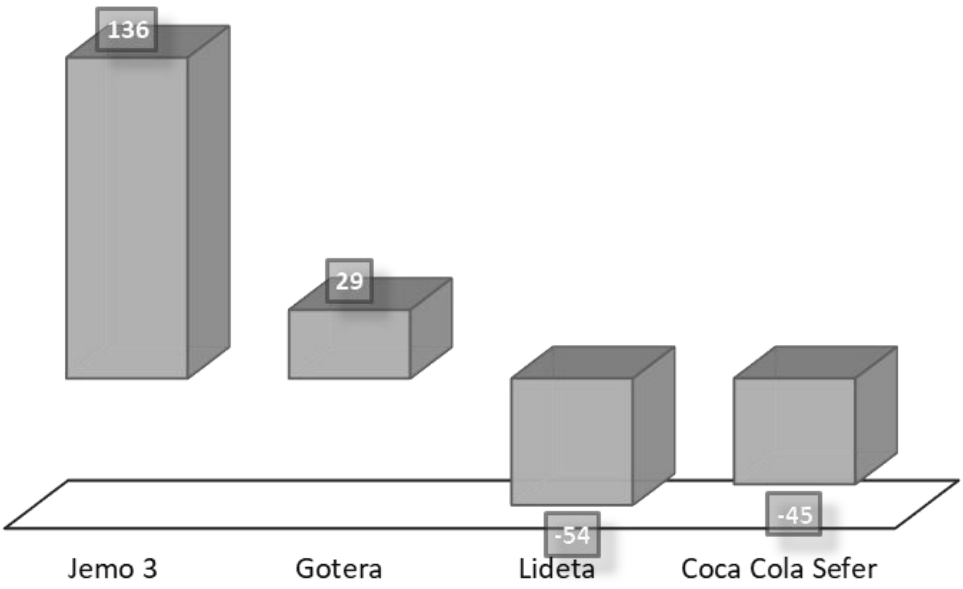


Figure 6 GRD percentage below/above the minimum expected threshold in the structural plan of Addis Ababa

On the contrary, four sites, namely; Gerji Emperial condominium, Tourist site condominiums, Kolfe Keranio Condominiums, and cooperative housing found in CMC could archive more than double the minimum requirement, whereas, the rest achieved more gross density ranging in a range of 3% to 90%. Figure 6 shows how much percent each study site achieved above or below the expected minimum threshold.

The study also revealed that the Gotera condominium has achieved the highest residential density, not only based on the highest GRD record it showed but also based on the lowest BAR it exhibited. Figures 7 shows the mean GRD along BAR in the gross residential density study sites.

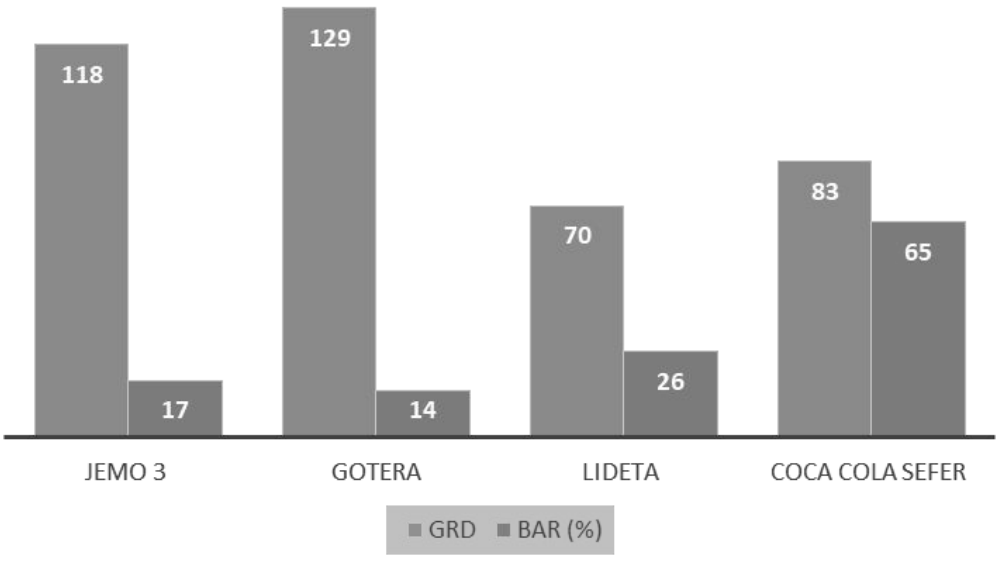


Figure 7 Mean GRD and BAR for Gross Residential Density Study Sites

Section IV Conclusion

From this study, one can understand that the mere result of the net and gross residential density may not fully inform decisions regarding building typologies in a given area. Rather, from this study, it became clear that it is the combination of net and gross residential density with built-up ratio (BAR) that gives a better understanding of existing settlements as indicated below.

The study revealed that residential density across most of the study sites is medium and below medium compared with both local and international residential density standards. Compared with the UN Habitat`s residential density standard, six out of ten study sites showed medium to very low net residential density. Nevertheless, the net residential density in condominium sites is higher than in other sites. Moreover, the study revealed that 20/80, 40/60 condominiums, Real Estates, and Cooperative Housings are the four housing typologies hosting the largest mean residential densities respectively. The 20/80 condominium scheme could achieve the highest mean residential density which is 182 DU/Ha net residential density on only one-fifth of the total area of sites studied. This proportion is equivalent to a 20% built-up area ratio (BAR). On the contrary, even if the 40/60 condominium scheme could achieve the second-highest mean net residential density, which is 171 DU/Ha Net residential density, It required 29% BAR to accommodate the above-stated number of households.

The result of the gross residential density study in the four study sites is mixed. When the recorded gross residential density in the study sites is compared against the gross density requirement of the structural plan of Addis Ababa, the study sites found in the inner-city, namely; Lideta and Coca-Cola Sefer exhibited below 150 DU/Ha minimum gross residential density requirement stated in the structural plan of Addis Ababa for high density mixed residence areas. Yet, the rest two sites, Goter and Jemo 3 which are respectively located in the intermediate and periphery of the city are well above the minimum gross-density requirement of 100 DU/Ha and 50 DU/Ha respectively.

One can conclude from the study that the vertical densification approach tried by the city administration of Addis Ababa in the form of condominium projects and real estate could enable the city to accommodate a higher number of households in a limited tract of land. Yet, the recently developed 40/60 condominiums even though they are high rise compared with the other two schemes (10/90 and 20/80), it achieved less residential density. However, their building height is much higher than all forms of residences studied. The 20/80 condominiums achieved comparable residential density in a much smaller tract of land. Thus, one important lesson one can draw from this study is that constructing high-rise buildings alone can`t guarantee effective vertical densification unless efficient housing layout design is incorporated with it.

In addition to contents included within the scope of this study, parameters such as Floor Area Ratio (FAR) could haveenhanced the above findings. Thus, we intend to include FAR in our upcoming research. Notwithstanding this, we hope what is already revealed in this study could be of benefit to practitioners, policymakers and academics.

Refernces

Habitat, U. N. (2012). Leveraging density: Urban Patterns for a Green Economy. Nairobi, Kenya.

Addis Ababa City Plan Preparation Office (AACPPO). (2017). Addis Ababa City Structure Plan. Addis Ababa, Ethiopia

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