



**HAL**  
open science

# Complex densities - From big data to a more human and sensitive city

Sandro Varano, Emmanuelle Rombach, Olivier Poulat

## ► To cite this version:

Sandro Varano, Emmanuelle Rombach, Olivier Poulat. Complex densities - From big data to a more human and sensitive city. S.ARCH 2018 : The 5th International Conference on Architecture and Built Environment with AWARDS, May 2018, Venice, Italy. hal-03935705

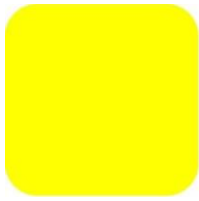
**HAL Id: hal-03935705**

**<https://hal.science/hal-03935705>**

Submitted on 24 Apr 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



## COMPLEX DENSITIES FROM BIG DATA TO A MORE HUMAN AND SENSITIVE CITY

Sandro VARANO, Emmanuelle ROMBACH, Olivier POULAT

École Nationale Supérieure d'Architecture de Strasbourg (ENSAS), Architecture  
Morphologie/Morphogenèse Urbaine et Projet (AMUP - EA 7309)  
6-8 Boulevard du Président Wilson, 67068, Strasbourg, France,  
emmanuelle.rombach@strasbourg.archi.fr

### Abstract

The paper presents the results of the workshop "From big data to a more human and sensitive city" that's associates the studio "Complex Densities" (École Nationale Supérieure d'Architecture de Strasbourg) to the Kamla Raheja Vidyanidhi Institute for Architecture and Environmental Studies (KRVIA) of Mumbai (India). The workshop proposes to experiment a parametric approach for teaching architecture and urban design in high density. So, on the basis of the works committed in the workshop, this article introduces a reflection on parametric modelling as design assistance.

### Keywords

French-Indian Workshop, urban density, parametric models, interactive processes.

## 1 Introduction

The collaboration between the studio "Complex Densities" (ENSAS) and the Kamla Raheja Vidyanidhi Institute for Architecture and Environmental Studies (KRVIA) of Mumbai (India), has led to the workshop entitled "From big data to a more human and sensitive city" that should occur during two weeks each November from 2017 to 2020. At the end of this three steps, a shared publication will be written by the both French and Indian schools of architecture.

The studio "Complex Densities" (Master 1 – Semester 1) aims to make the students sensitive to urban density situations of the contemporary cities. The studio also encourages students to question the notion of density in relation to urban typologies. A thorough analysis of existing urban typologies viewed both from the morphological angle in their socio-economic and demographic content allows the students to link spatial device, encrypted density and the way of living in the city. The studio proposes to train students in using parametric computer design dedicated to architectural and urban design. The parametric approach proposed encourages students to clarify their intentions in relation to all themes of the project. The experimentation is based on the nesting of scales by moving back and forth between micro and macro territory. This approach offers the possibility to integrate very

quickly a lot of data, and to check the "positive/negative" interactions on a territory. This allows in particular early measurement of the project's effects on the urban microclimate and the possibility to correct iteratively space assets considered.

Moreover, the studio "Complex Densities" takes part to an international exchange, based on the collaboration with the KRVIA of Mumbai.

The KRVIA offers a full time Masters courses (M.Arch. - Urban Design). The discipline of Urban Design addresses the areas that lie in between the strict disciplinary boundaries of architecture, Urban Planning, Landscape Planning, Infrastructural Planning and Environmental Planning. Each of this discipline derives its own method of operations while KRVIA Master's in Urban Design endeavors' collective and multi disciplinary approach for public domain where this strict compartmentalization are erased for integrated and complementary exchanges.

The workshop is organized in 2 steps and proposes to experiment a parametric approach for teaching architecture and urban design in high density :

Step 1 – students of ENSAS in Mumbai November 1-12<sup>th</sup> 2017 : "Learning from India, learning from Mumbai" ;

step 2 – students of KRVIA in Strasbourg November 22-30<sup>th</sup> : "Learning from Europe, learning from Rhine countries".

The workshop is devoted to collective research and analysis on the cities of Mumbai and Strasbourg. The students identify possible sites for the project. In parallel, they follow specific parametric computer training from didactic exercises directly related to the chosen contexts. From a quantitative dimension, the approach is based on numerous and diverse data transcribed into diagrams and parametric models. So, the data parameters are progressively integrated into the project, which ultimately will have to reach a level of complexity to match the context in which it operates.

The research reflects on parametric modelling as design assistance for architecture and urban design.

## 2 Step 1 : "Learning from India, learning from Mumbai"

The step 1 of the workshop focuses on studying local densities of various fabrics within the city of Mumbai. This first approach allows to extract parameters, first in order to measure the existing density, secondly to study various densities on other sites.

The end result of the step 1 is a representation of various densities with respect to built space per person, density, floor space index (FSI), ground coverage and the required amenities as per standards using parametric modelling.

### 2.1 Studying urban sites

The first part of the workshop includes the visit of 3 remarkable sites where the relation between quality of life and density can be considered as ideal examples to learn from. The 3 visited sites were the "BDD Chawls", "Site & Services" and "Old Housing" (Figure 1).



Figure 1. 3 study areas in Mumbai

This approach allows to develop a collective analysis of sites (pictures, drawing, research in the KRVA library, ...), understanding the location, looking for the specificities, measuring the existing densities, ...

## 2.2 Identifying parameters

The parameters identified and used for the study of densities appear in Figure 2.

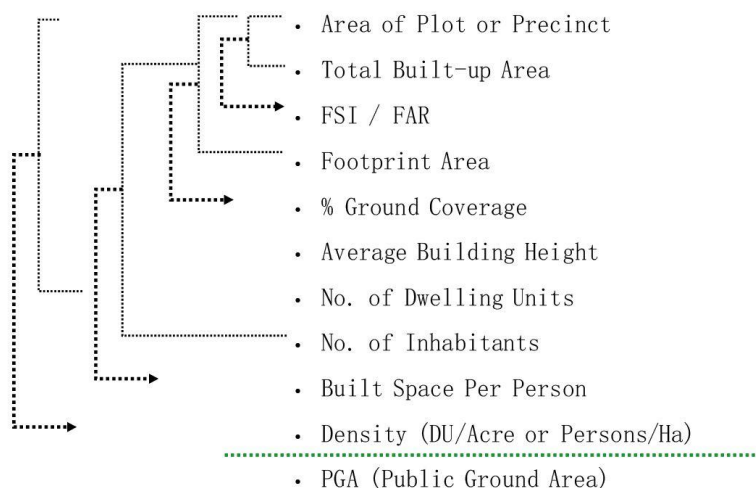


Figure 2. Parameters for analysis

This approach uses two parametric computer tools : the algorithmic software *Grasshopper* which is combined with the geometric modelling tool *Rhino 3D*. The students are gradually introduced to the application of the software. The aim is to introduce the students to new IT tools while experimenting urban project starting from quantitative data in order to produce a qualitative and measurable project. This parametric modelling work involves a re-transcription of the parameters into computer data (Figure 3).

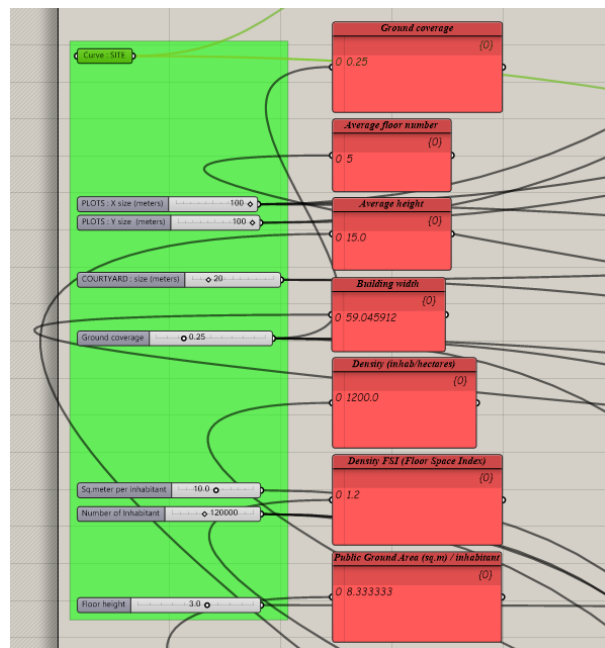


Figure 3. Grasshopper script illustrating the input and output parameters

### 2.3 Analysis of the parameters of 6 sites in Mumbai by 6 groups of ENSAS-KRVIA students

6 different sites (Figure 4) have been chosen for their issues in terms of location, heritage, density, and given for analysis to 6 groups of ENSAS-KRVIA students.

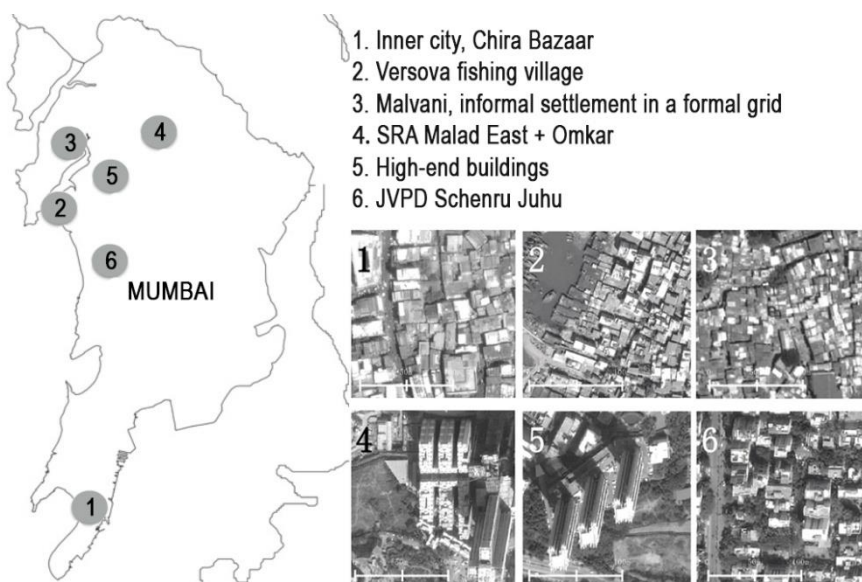


Figure 4. 6 case studies in Mumbai

The sites analysis aims to understand the great quality and diversity of housing's typologies in Mumbai (original fishing villages, colonial and modern heritage, contemporary architecture, informal settlements, ...). This case studies allow to take into account the scale of a so huge mega city in terms of climate, Indian culture, street's ambiances, mobility, water, food, waste, building materials, ... For each case study, the analysis deals with density in terms of quantities/data and of qualities/ambiances.

- Inner city, Chira Bazaar (Figure 5)

is a 30 acre site located in the west part of Mumbai. The houses are in majority inhabited by Christian and Hindu people. Four main typologies are noticed, really different as far as uses and shapes are considered. Apart the old architecture tribute, the strong community bond is the only historical asset of the site. The site is planned awkwardly with inadequate roads and a huge congestion due to cars. One of the specificity of that site is its mixed use ground floor: shops, offices, apartments. This mixity creates a particular atmosphere. Finally the pedestrian traffic becomes enjoyable, voices of storekeepers and smells of street food make this place a great lively place.

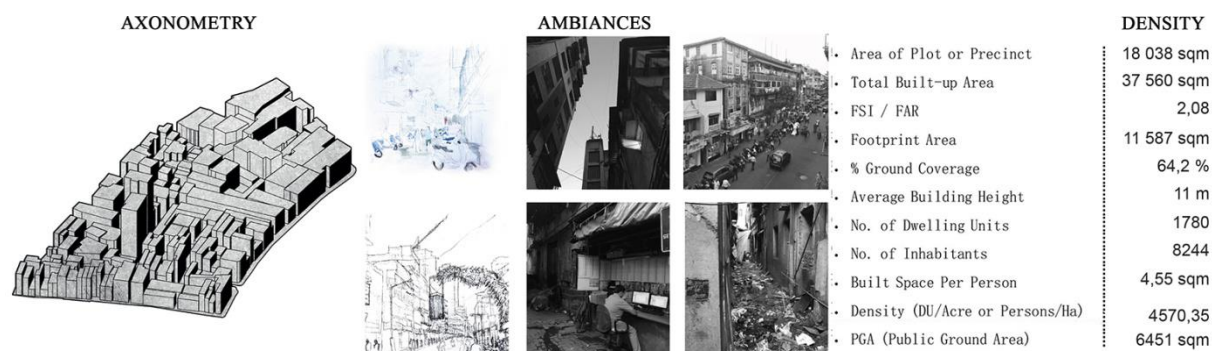


Figure 5. Inner city, Chira Bazaar analysis

- Versova fishing village (Figure 6)

is one of the original fishing villages of the former original Mumbai's archipel. This is a vernacular urban district progressively built by its inhabitants and now equipped with sewage, drinkable water and electricity. The Versova village is a mixed district of housing. Six different typologies of housing produce a great diversity into the neighbourhood adding a kind of village ambiance. The collective in-between spaces are private spaces belonging to the village community. However these urban spaces are open to everybody and used for domestic functions and collective interaction. Bamboos structures dedicated to dry the fish are built in front of the beach, behind the fishermen houses. The strong smell of the fish, the bamboos structures, the wastes coming from the sea, the uses of the beach as playground for children contribute to the specificity of this part of the western Mumbai's coast and reveals the complexity of this urban dense shape.

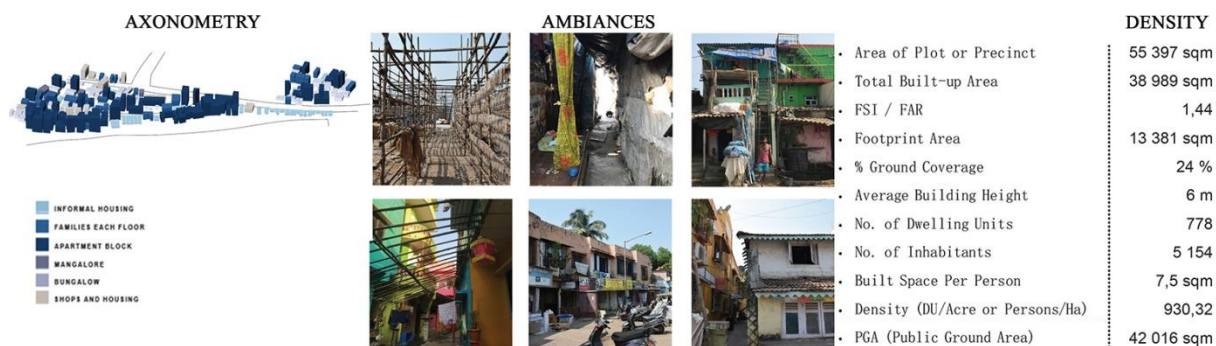


Figure 6. Versova fishing village analysis

- Malvani, informal settlement in a formal grid (Figure 7)

is a high dense district based on a formal grid of blocks of 60 m x 60 m originally dedicated to redevelop slums. At the beginning of this new district, the inhabitants were invited to build

their home by themselves according to proposed models of housing. The ground floor open to the surrounding streets could be occupied by shops. The courtyard was equipped by collective toilets. The inhabitants of Malvani have progressively put by themselves some great mutations in the original diagram. The collective toilets have been abandoned for individual ones. At the same time, the collective in-between spaces have been partially filled up with private stairs for new floors added on the top of the existing houses. The result is a lively district which questions the way of making the city by involving the inhabitants.

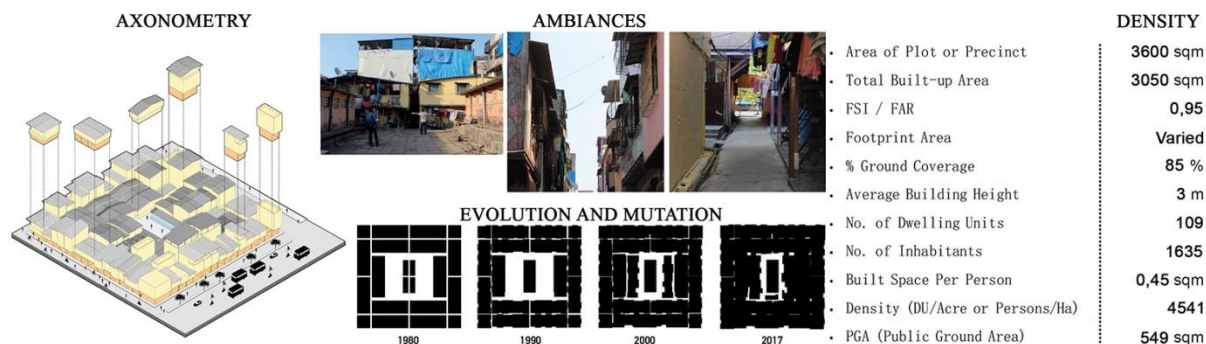


Figure 7. Malvani analysis, informal settlement in a formal grid

- SRA Malad East + Omkar (Figure 8)

questions the relation between two typologies of housing located on the plot of a former slum : SRA Malad East social housing built by the local government for the redevelopment of the slum ; Omkar skyscrapers and car park built by a private developer for upper classes. The impact of the height of the skyscrapers and their proximity to the SRA buildings generate small prospect, direct view, mask effect and drop shadows. The majority of families who lived in the old slums obtained one or more dwellings according to the surface inhabited before the redevelopment, but the site lost its identity, its mixed use specificity and its wealth which characterize the slums.

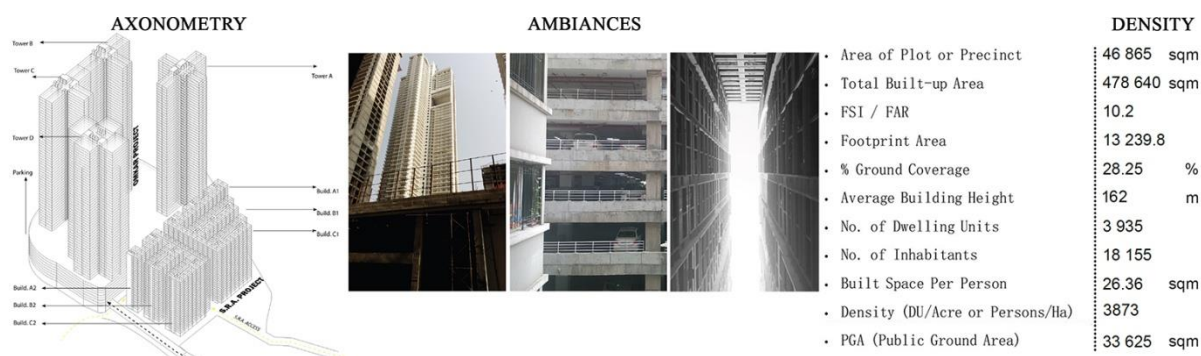


Figure 8. SRA Malad East + Omkar analysis

- High-end buildings (Figure 9)

is a generic contemporary typology of housing built by private developers for upper classes. The skyscrapers offer big and comfortable housing if possible with view on the sea. The whole plot is closed by walls and built by a great car park of several floors, which disconnects the typology with the public space and creates a gated community for rich people. The density is low in comparison with the height and the impact of the building in the landscape and the neighbourhood.

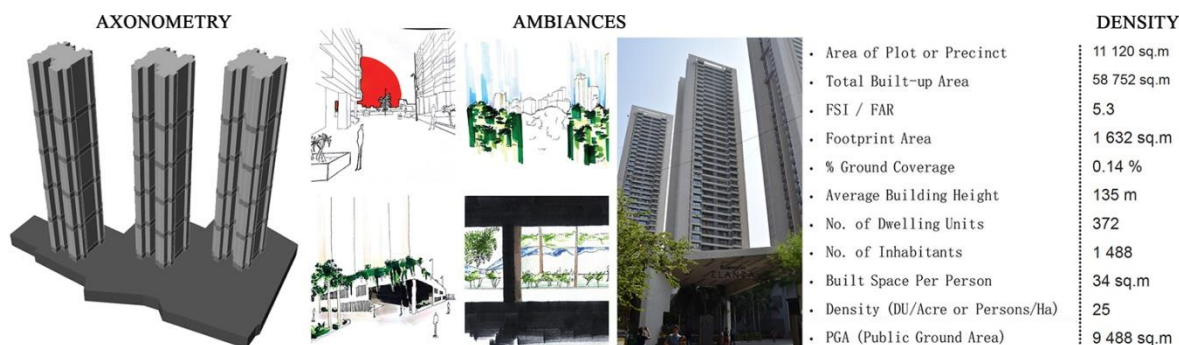


Figure 9. High-end buildings analysis

- JVPD Schenru Juhu (Figure 10)

Juhu is one of the most expensive neighbourhood of Mumbai, defined by its quite low density, in contrast with the average density of Mumbai. The site is part of a grid of quite regular blocks divided in private plots. The residential buildings are at a regular distance of the plot's limits. The firsts floors are usually occupied by (level) car park and the plots are usually surrounded by high blind walls, which disconnects the buildings to the streets. The high trees, planted in the streets or in the plots bring fresh air and shadow to the streets and create a nice microclimate. The quality of the housing is also remarkable as far as the quality of the plan and the natural lighting are considered.



Figure 10. JVPD Schenru Juhu analysis

The final review of the step 1 took place in ENSA Strasbourg. It consisted in the final presentation of the analysis of the 6 sites by the 6 ENSAS-KRVIA groups of students. A global tab presented the comparison between the site's parameters and revealed the contrasts in terms of data and ambiances.

### 3 Step 2 : "Learning from Europe, learning from Rhine countries"

For the step 2 which took place during one week in Strasbourg, the 6 groups of KRVIA-ENSAS students have had to imagine on a one hectare plot, the most efficient, compact, mixed, dense and generous urban project inspired by the context of the 6 Mumbai's case studies.

For that, the students have participated to an architecture tour in Strasbourg and Basel and have visited some interesting and inspiring housing typologies built between the 19<sup>th</sup> century and today.

For that step, the project has been directly associated to the parametric computer tool. Each group has had to translate their design intentions into a parametric model. A parametric



model is a set of connected heterogeneous elements [1] [2], describing a visible geometry in *Rhino 3D* called "instance". An instance evolves each time the parameters of the model are modified. So, these instances are in scope of possible geometric solutions. This parametric modelling work gives two levels in architectural or urban design : the design of a parametric model and the design of an instance [3].

The 6 following projects illustrate different density process :

- Inner city, Chira Bazaar (Figure 11)

The project keeps the main parameters of the existing site : mixed use ground floor, traditional housing typologies and proposes an urban matrix that clarifies and improves the quality of the public outdoor spaces and of the indoor collective corridors.

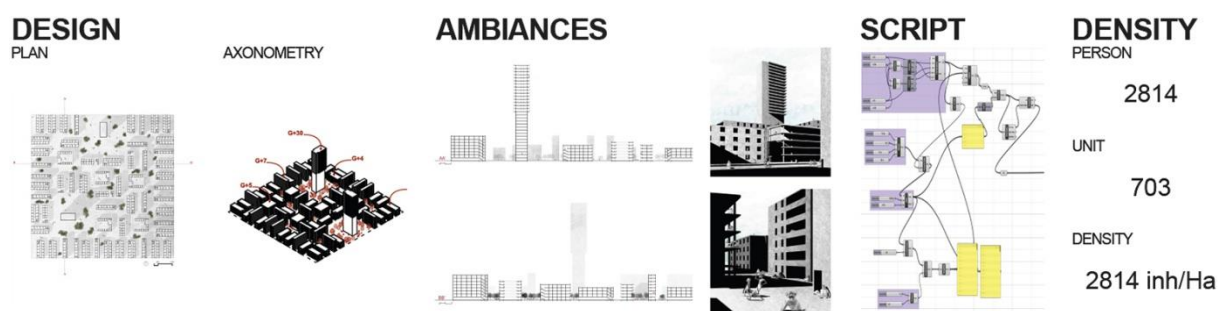


Figure 11. Inner city, Chira Bazaar project

- Versova fishing village (Figure 12)

The students propose to re-use the traditional housing typologies by mixing them together in higher building than the original one, in order to maintain the density at the same time they try to improve the quality of the in-between public spaces.



Figure 12. Versova fishing village project

- Malvani, informal settlement in a formal grid (Figure 13)

The students imagine a play which rules are proposed by the local government to the inhabitants in order to involve them more deeply in the urban fabric. This play re-uses the principal of the dominos. The grid is divided in small and regular plots which could be either a building or a void. Each family has a double plot divided in two areas, one for private housing, the other for collective outdoor spaces. Each family is compelled to connect the void of its plot to the voids of the plots of its neighbours. The public or collective spaces are in that way drawn by the inhabitants themselves.



Figure 13. Malvani, Domino's project

- SRA Malad East + Omkar (Figure 14)

Students doesn't want to keep the principal of the both existing typologies considered as non efficient in terms of ambiances and social relationships. So they try to propose a more balanced typology with an average density, made of several small towers either based on a car park ground floor or associated to a level park tower.

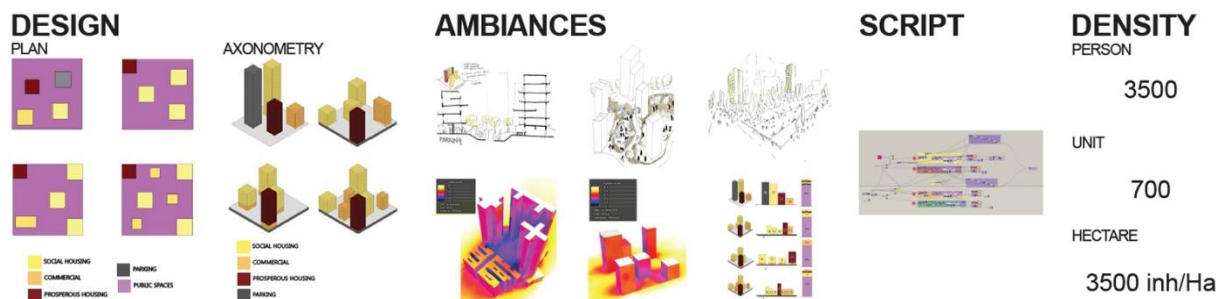


Figure 14. SRA Malad East + Omkar project

- High-end buildings (Figure 15)

The tiny foot print of the skyscrapers is considered as an efficient parameter to improve the renewal of the mangrove. The collective ground floor is abandoned for some bridges creating collective relationship between towers at different levels. The metro line crosses the district and connect it to the city. The result is a more porous and open figure even if its inhabitants should certainly belong to the upper classes.

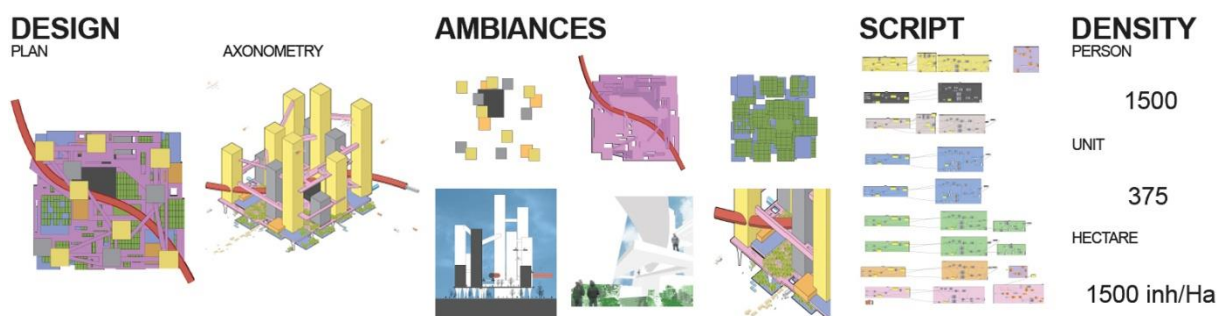


Figure 15. High-end buildings project

- JVPD Schenru Juhu (Figure 16)

The main parameters of the existing typology have been maintained. The students propose to open the private walls in order to create some porosity between the private plots that could be crossed by pedestrians. The roof tops could become urban farms. The car parks

have been put in the second and third floor in order that the ground floors could be given to shops and amenities open to the street.



Figure 16. JVPD Schenru Juhu project

## 4 Conclusion

The workshop scheduled in two steps has allowed to put in place a training method that mixes analysis and design, data and ambiances in a complementary approach of designing today a project in a complex and dense context.

This approach also has offered the possibility of a more scientific approach of sensitive and human conditions of living. This attitude has allowed to build a rigorous comparison between the different case studies. It has only taken one week to analyse the parameters of six different complex urban situations and less than one week to propose new urban typologies inspired by the best qualities of each existing sites. This has also been the opportunity for the students to measure with precision what is a density, to debate about the question of the citizenship, to identify the qualities of housing, etc ...

This workshop has been of course also a huge opportunity for our students and for their teachers to work together along the month of November. The workshop has made possible a great and nice exchange between Indian and European students that have understood that their visions and cultures are not so far to each other as far as the question of designing the city is concerned.

## References

- [1] Barrios Carlos, *Cognitive models for parametric design*, Proceedings of the 11<sup>th</sup> Iberoamerican Congress of Digital Graphics, SIGraDi 2007, Mexico, pp. 239-242
- [2] Gane Victor, Haymaker John, *Conceptual Design of High-rises with Parametric Methods*, In *Knowledge Modelling*, 25th eCAADe Conference Proceedings, Stanford University, USA, 2007, pp. 293-302
- [3] de Boissieu Aurélie, Lecourtois Caroline, Guéna François, *Enseigner la conception architecturale avec la modélisation paramétrique : Quelle spécificité cognitive ? Actes du colloque 01Design.7 Conception assistée par concepteur*, Europaia, Paris, 2010