Clément GOSSELIN
Architecte HMONP
www.clementldgosselin.eu

PORTFOLIO

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-CAIB6 OFFICE REHABILITATION.
-BNPMAT OFFICE REHABILITATION.
-SPORT FACILITY PROJECT IN BARENTIN.
-RECONSTRUCTION AND EXTENSION OF AN INDIVIDUAL HOUSE IN BOIS-GUILLAUME.
-COLLEGE COMPETITION IN MARSEILLE.
-HOUSING IN CLAMART.
-YOUNG WORKERS HOUSING.
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-MACHINE VISION.
-RECEARCH CENTER IN ALMONT, CANADA.
-MODULAR HOUSING
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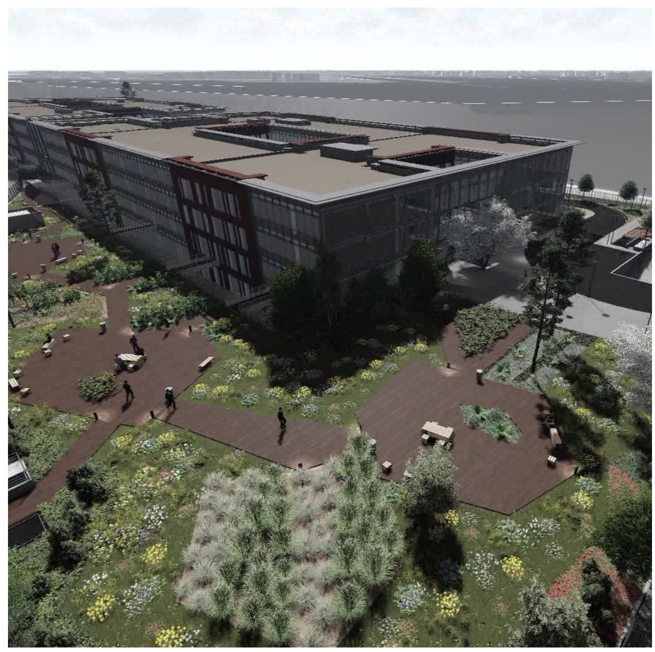
Professionnal Projects

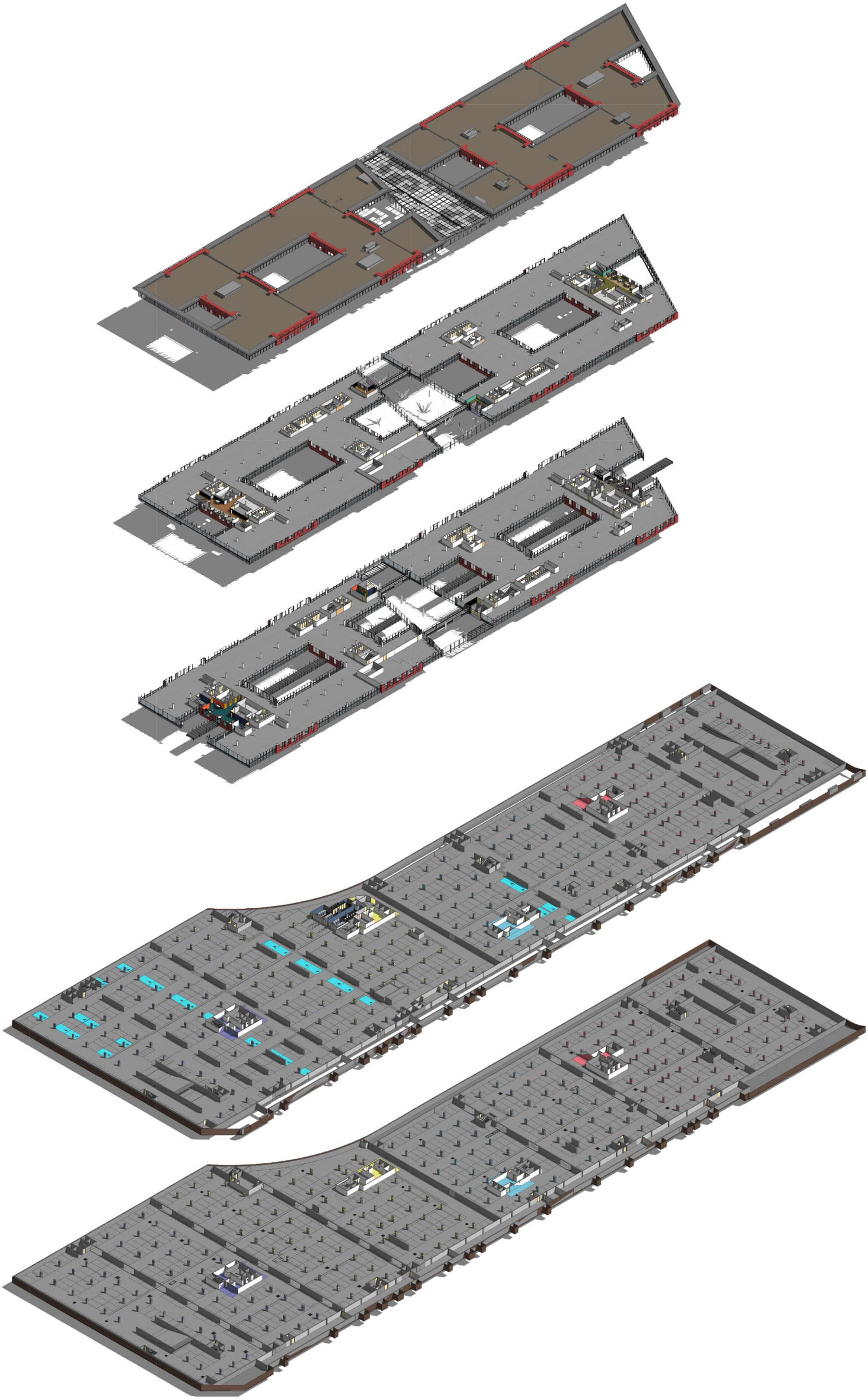
CAIB6

Architecture office : Pascal Dalous Architecte
Team : Pascal Dalous, Donatien Dalous, Felix Buschinger, Clément Gosselin, Thibault Maunoury, Laure Mechiche, Eleonora Toulis.
Date : 2016 - 2017

It is a rehabilitation project of a 36 000 m² office in Vélisy. This building was originally built for PSA company and contains specific equipments linked to its professional activity such as security process and cars showrooms with confidentiality processes to present prototypes. Because PSA left the facility, the building owner decides to rehabilitate it in a several tenant office.

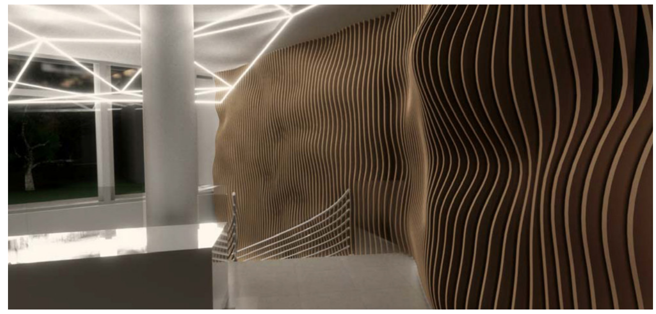
The building owner decides to take advantage of this project to increase the building density (allow the building to receive more employee, according to building regulations) and test new deliverable methods that takes the most of the new numeric tools (3D scan, BIM process, interactive model, scripting and visual programming, video rendering, real time rendering, and virtual reality) potential. The aim is to allow the owner to adapt its bid solicitation to these new numeric tools.



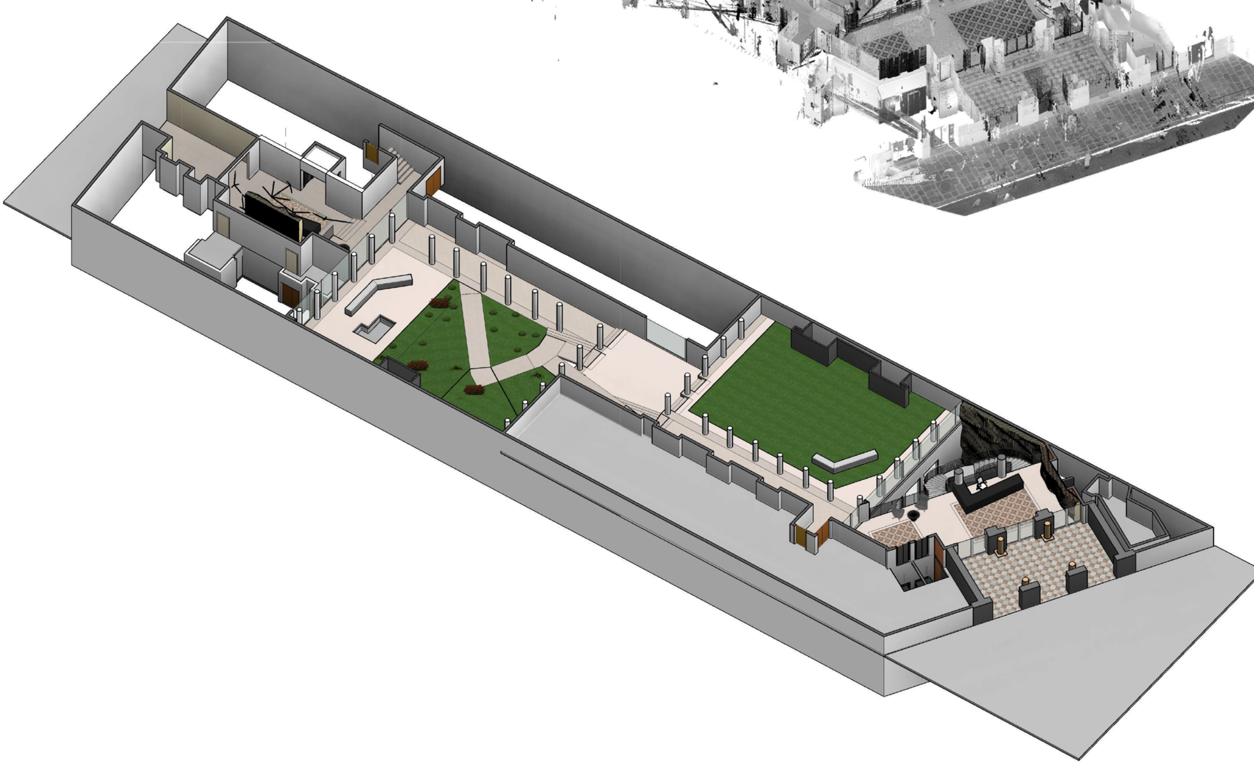


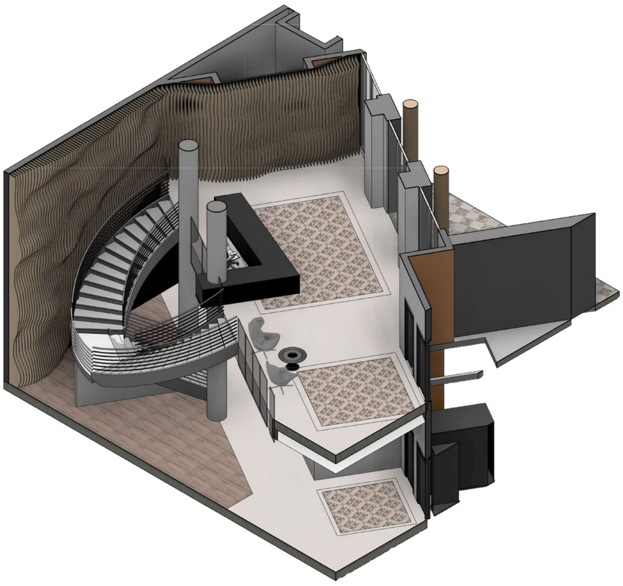
BNPMAT

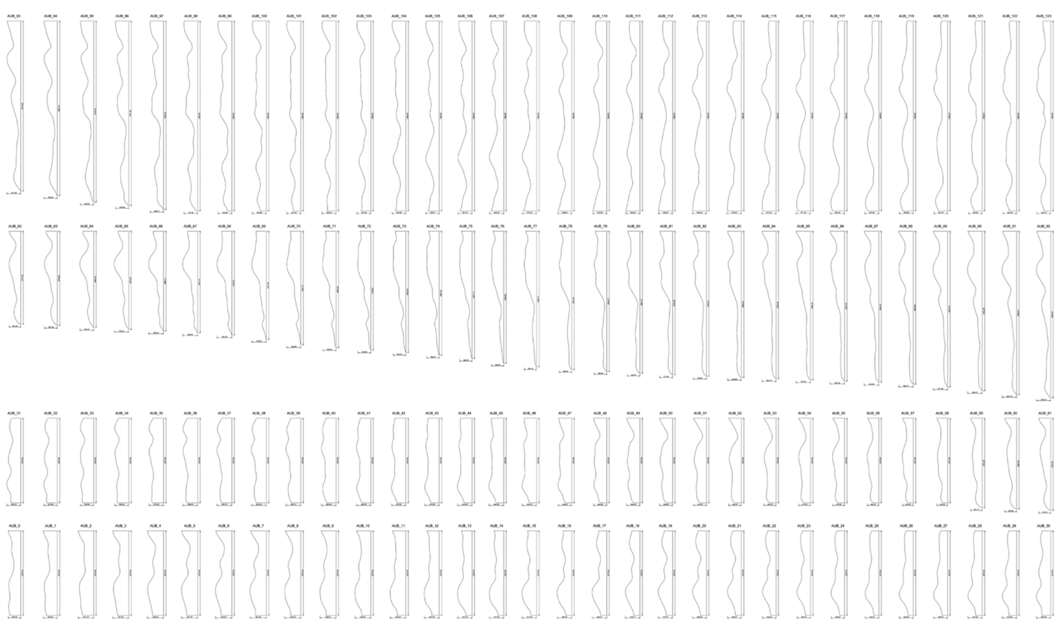
Architecture office : Pascal Dalous Architecte
Equipe : Donatien Dalous, Clément Gosselin
Date : 2016 - 2017

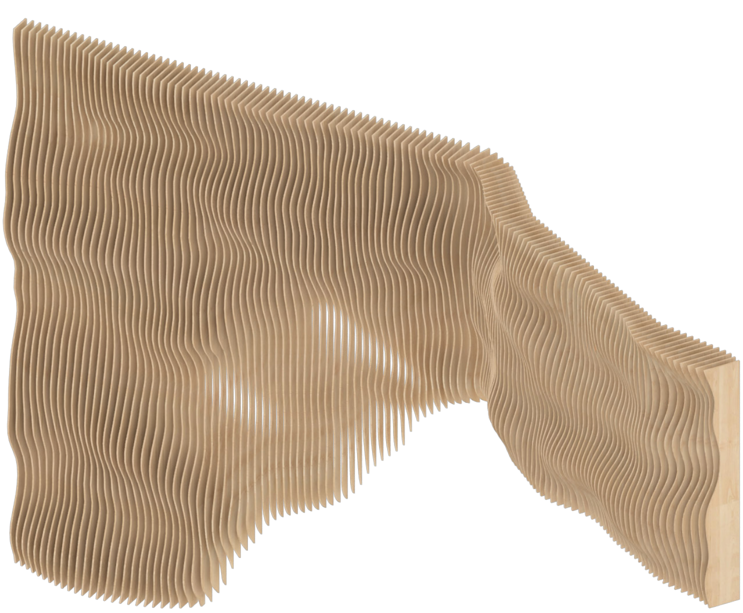


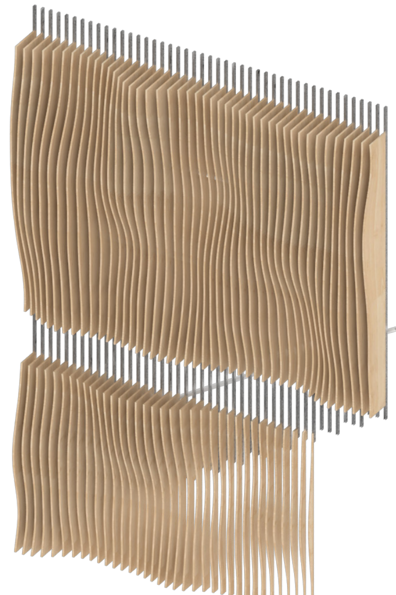
This is a reconstruction project for an office building entrance. The arrangement planing inclued furniture equipement realised with programing tools.
The parametric model was directly liked to the manufacturing planes. This has enable us to manipulate the inputs (board thickness, board number and board width) according to the fabrication cost.









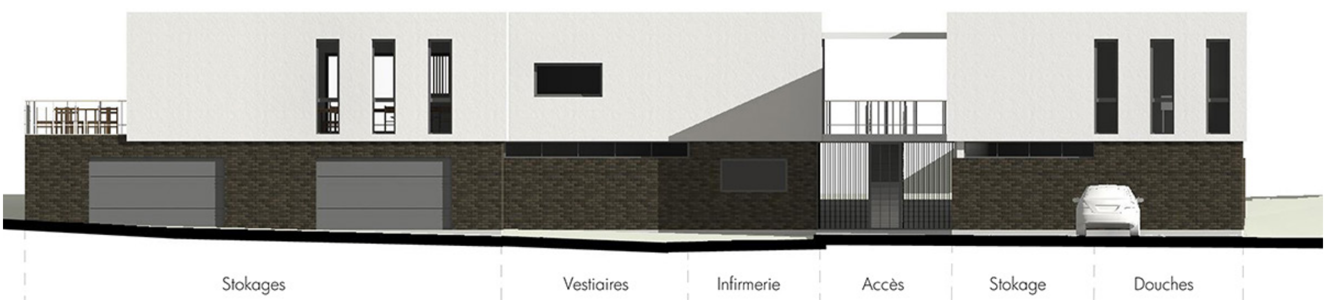


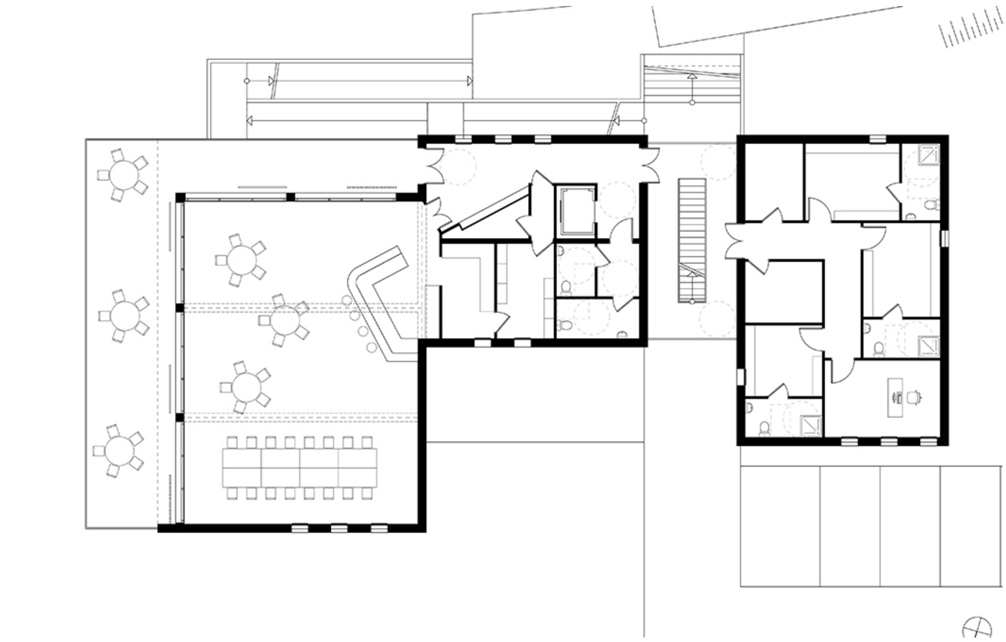
SPORT FACILITY PROJECT IN BARENTIN

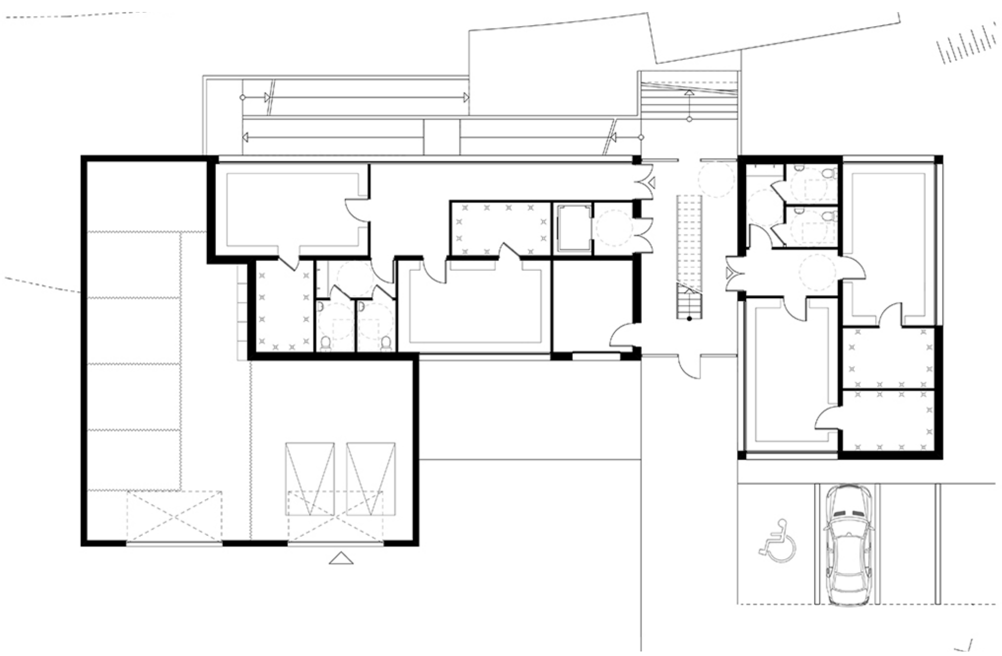
Agence : Jean-Marc Fabri Architecture
Team : Tiphaine Jaxel, Clément Gosselin
Date : July 2016

It is a two story sport facility project for Barentin city. The building program is divided in two parts. The first part is the clubhouse that should be used for the public reception (people that has no sport licence). The second part is devoted to sport. It includes cloakroom, showers and sporting goods storage.

Three sports fields depend on this building. They are accessible to all PRM. The building insertion has been thought depending on the different sport fields altimetry to reduce impact of accessibility equipment on the budget. The clubhouse is located on the second floor and offer a panoramic view over all the sports fields.

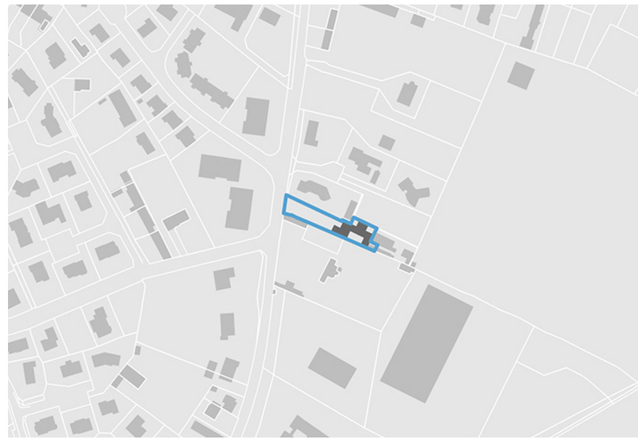






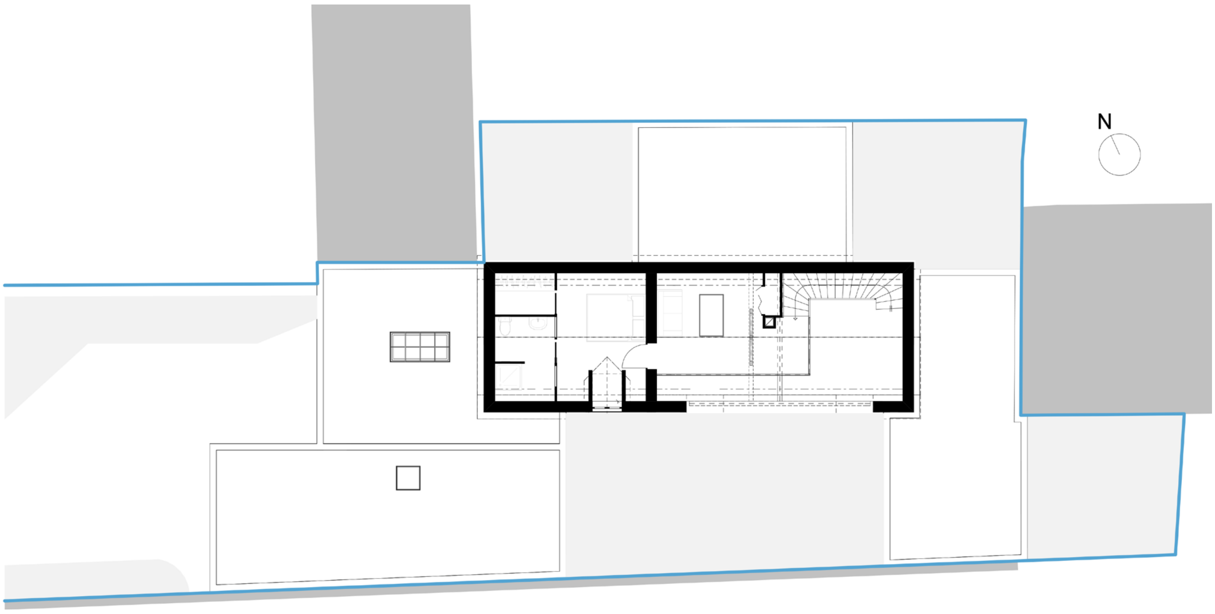
RECONSTRUCTION AND EXTENSION OF AN INDIVIDUAL HOUSE IN BOIS-GUILLAUME

Architectural Office: Jean-Marc Fabri Architecture
Team : Clément Gosselin



This is a reconstruction project for an individual house. The design project includes structural changes of the existing building, the conception of several extensions and the addition of one story in the existing building.

The project was entirely designed in ArchiCAD. I worked on this project during the conception phase.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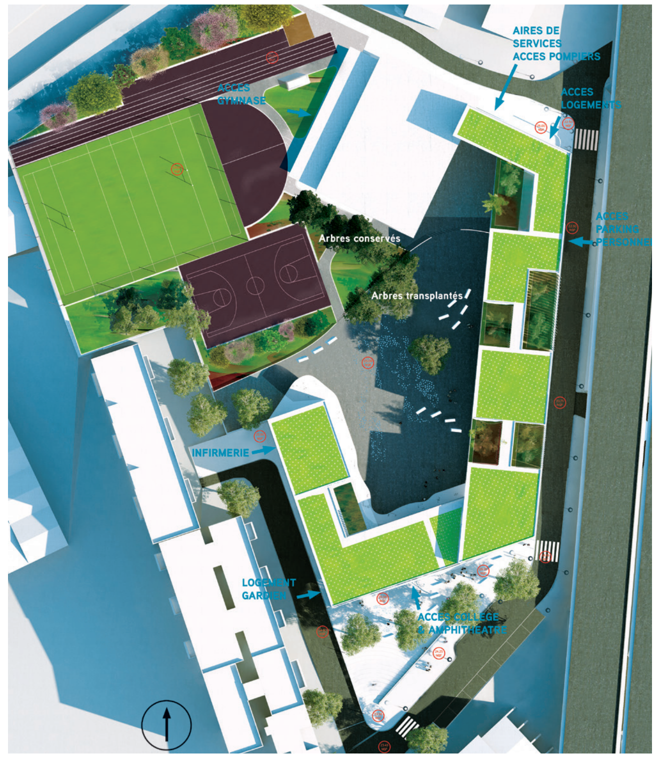
COLLEGE COMPETITION IN MARSEILLE

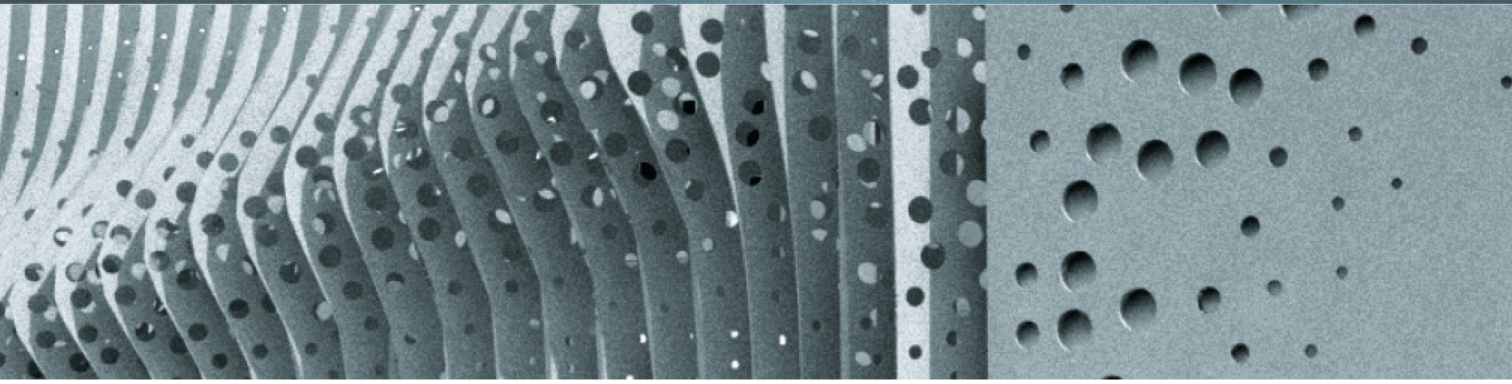
Architectural offices : EZCT & Marc Dalibard
Team : Felix Agide, Clément Gosselin, Philippe Roux, Mahriz Zakeri, Alban Mallet
Date : September 2015

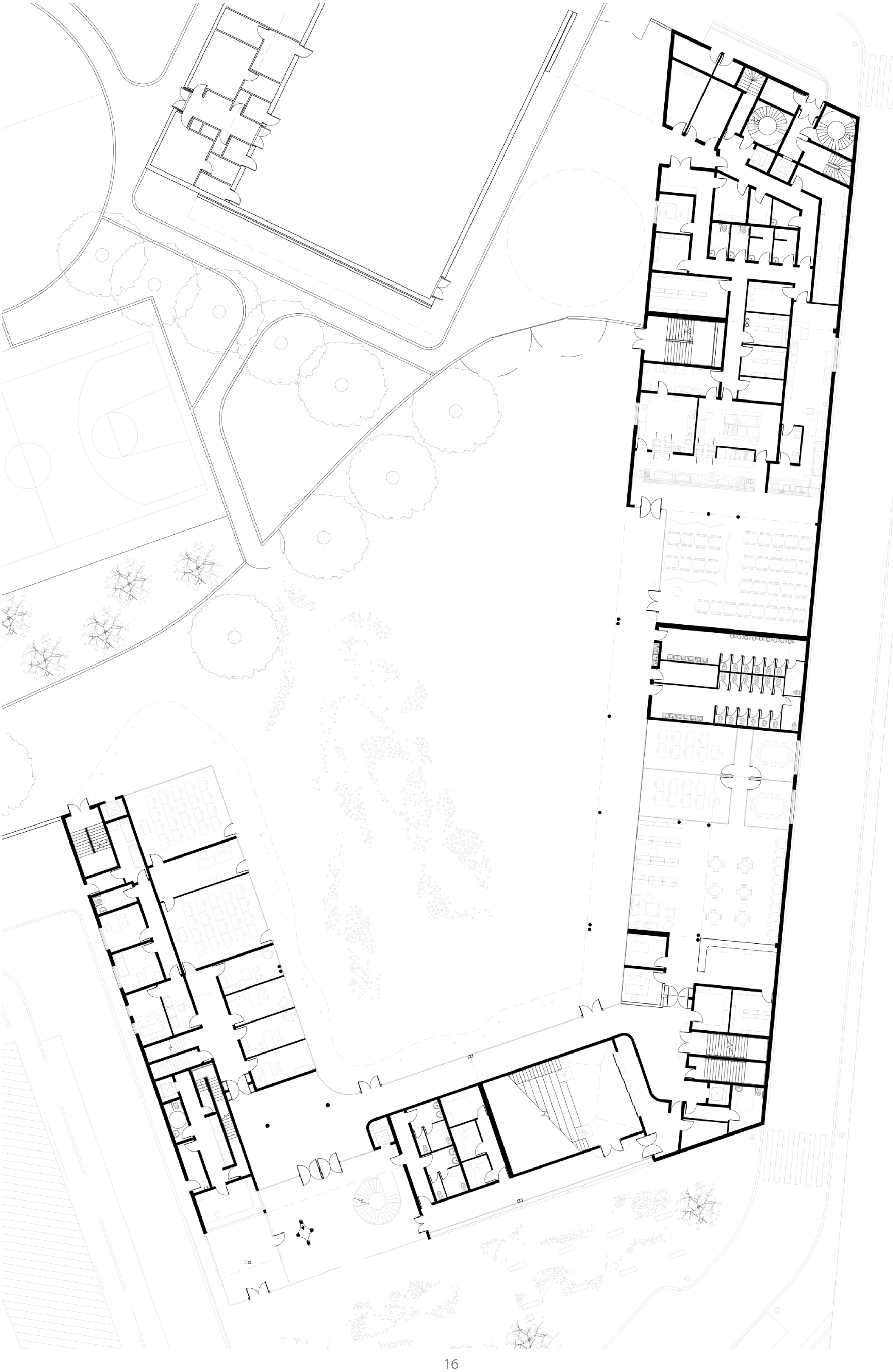
This is a reconstruction competition for a college project in Marseille. We suggested the construction of a new college along the highway that has the double benefit of protecting the schoolyard and sport fields from the highway pollutions (air and noise) and simplifying the phasing. Indeed, that way the old college could still be used during the construction work, there is no need to build a temporary college.

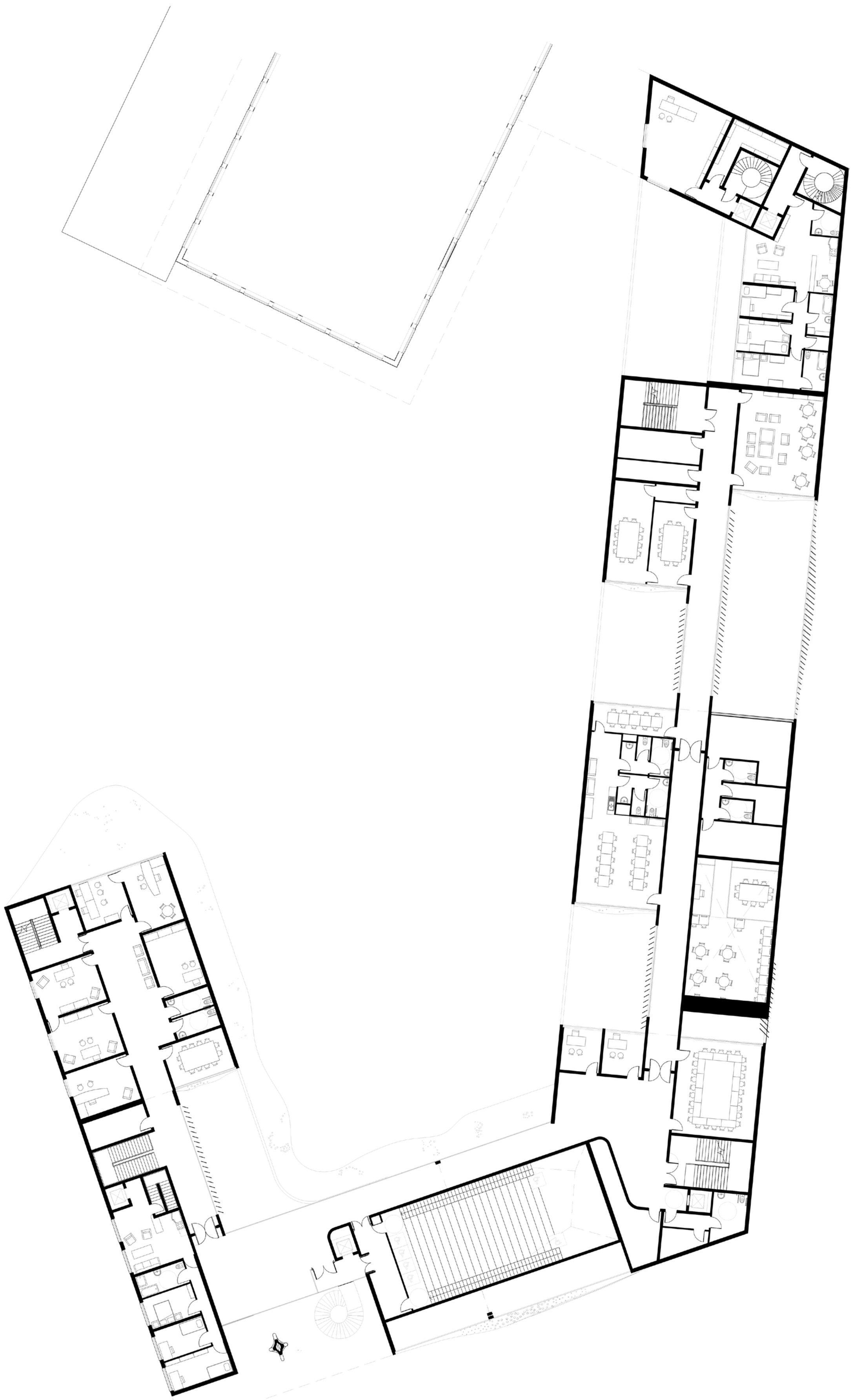
Particular care was taken to solve the issue of solar gain by adding solar shading designed on Rhino/ Grasshopper depending on the facade orientation. Furthermore, acoustic issues were solved by designing patios closed by an acoustic wall all along the highway.

The entire project was realised on Revit and Rhino Grasshopper.









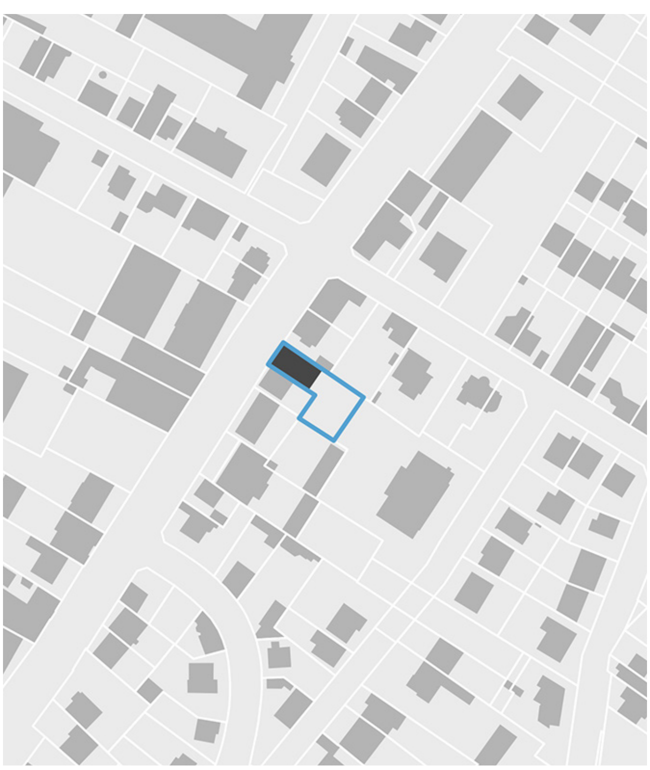
HOUSING IN CLAMART

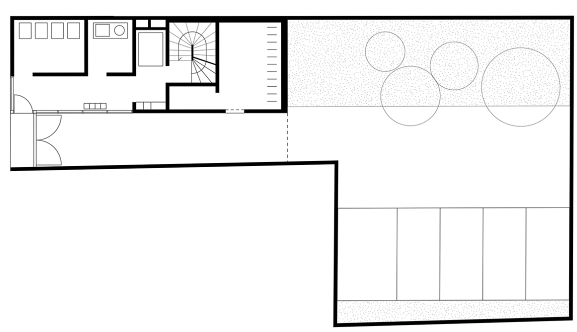
ARCHITECTURAL OFFICE : ITHAQUES
TEAM : ANNA BOGDAN, DANYEL THIÉBAUD, CLÉMENT GOSSELIN
DATE : 2014

It is a social housing project supported by "l'Habitat et l'Humanisme. The project is In Clamart, in a residential district, close to the city center, between the railway station and Clamart's wood. The railway station proximity is a great advantage given the project's nature.

An individual house occupied the existing plot. Because the district is being densified, the new project should easily integrate the urban fabric, composed of individual housing and six-storey collective housing.

The façade materials were chosen for their durability. This housing project should respect the thermal regulation RT2012 and produce 30% of the eating energy with renewable energy.





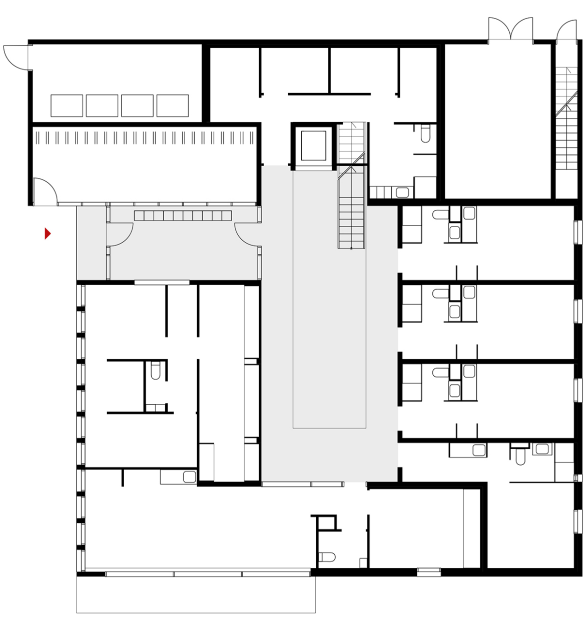
YOUNG WORKERS HOUSING

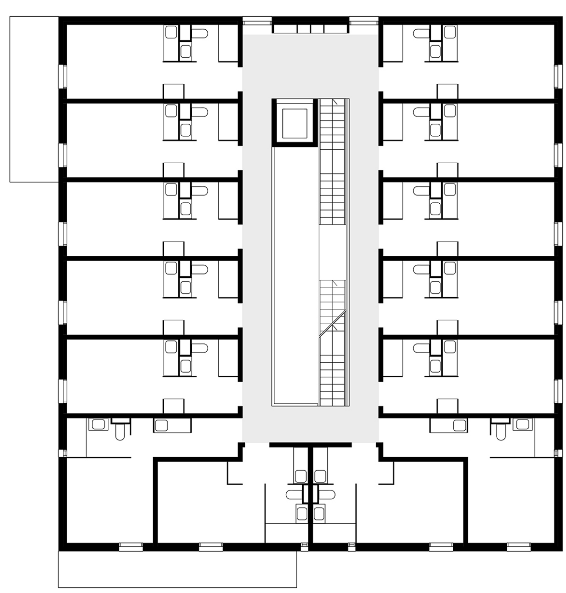
Architectural Office : Ithaques
Team : Anna Bogdan, Danyel Thiébaud, Clément Gosselin
Date : 2014

This young worker housing is a four-story building with a car park basement. It is a simple, calm and compact building organized around an atrium. The building occupation on the plot was limited to the strict minimum to keep a large distance from the building neighbors.

A large central atrium gathers the vertical circulations with an open staircase and an elevator. The corridors opened to the atrium leads to the studio apartments. This arrangement allows us to illuminate the circulation spaces with natural light and to avoid long dark corridors. Indeed, the atrium is being daylit by north oriented windows on every level and a large south oriented window on the top floor. The collective and technical spaces are located on the ground floor as well as some of the studio apartments. The other studio apartments are located on the upper floors. The multi-purpose hall is on the ground floor south Ouest building corner.

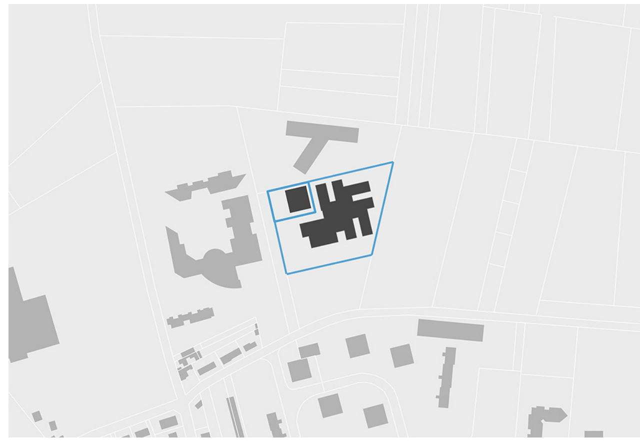
The studio apartments are organized on a regular grid, but thanks to the windows irregular disposition, several apartment arrangements are possible. None apartments are north oriented and almost half of the bathroom apartments has natural light. The facades are made of mold light concrete with a pattern like travertine stone. The ground floor carpentry works are made of metal. The upper floors carpentry works are made of PVC with rolling shutters.





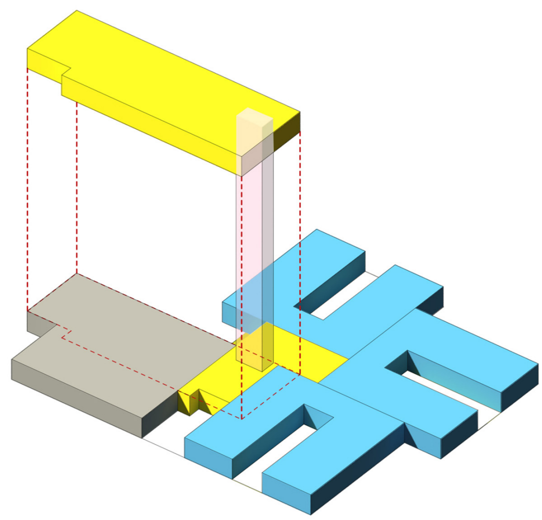
MEDICAL-CARE HOME

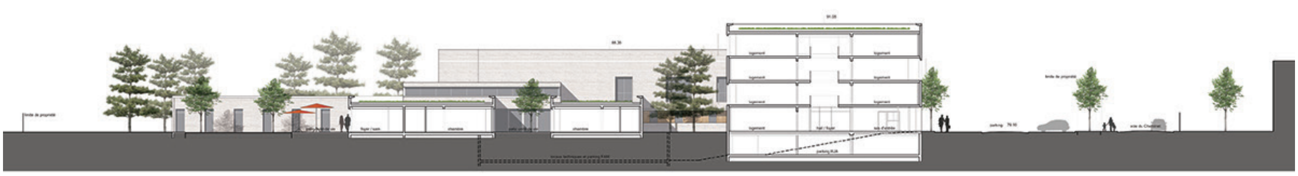
ARCHITECTURAL OFFICE : ITHAQUES
TEAM : ANNA BOGDAN, DANYEL THIÉBAUD, CLÉMENT GOSSELIN
DATE : 2014



This is a medical care home project. This kind of building intends to receive people with severe disabilities. It is a two-story building organized around patios. This typology allows us to organize the project as a large house where the collective spaces are located in the building center and distribute the privet spaces opened to the park. The program is divided into two levels and one partial basement level. The entrance, the administration office, the services and the living units are located on the ground floor. The medical center, and the activity rooms are located upstairs adjacent to a large terrace. In the basement are located the technical area and forty parking spots.

The living units are organized around patios. This outside space is accessible from each room. It preserves the units privacy and offer a view on the park. These patios are an intermediary space between a private space, the room, and a large outside space, the park.



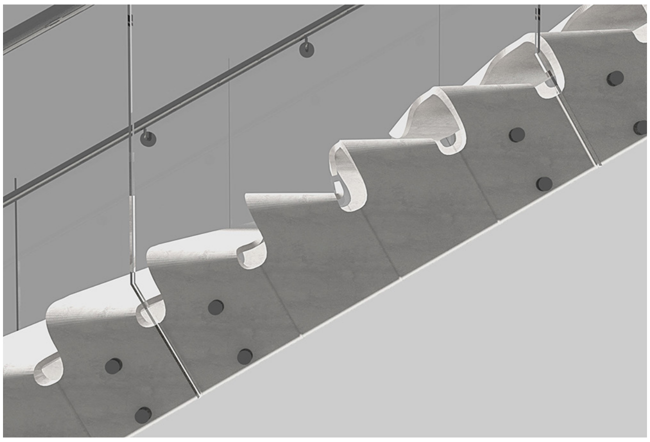


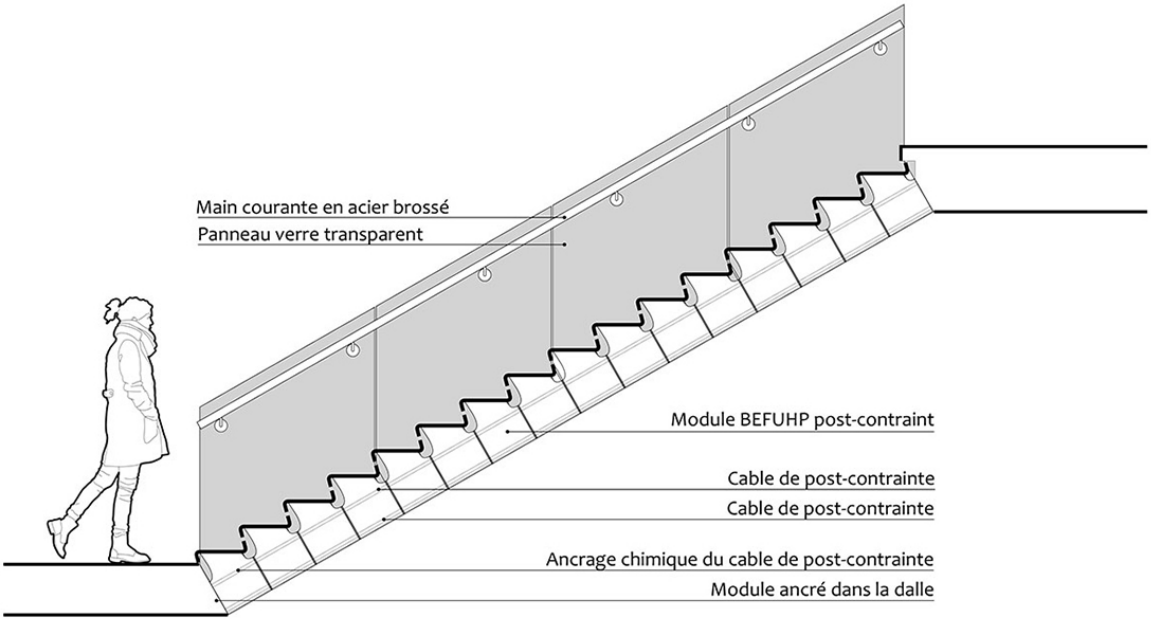
Idea competitions

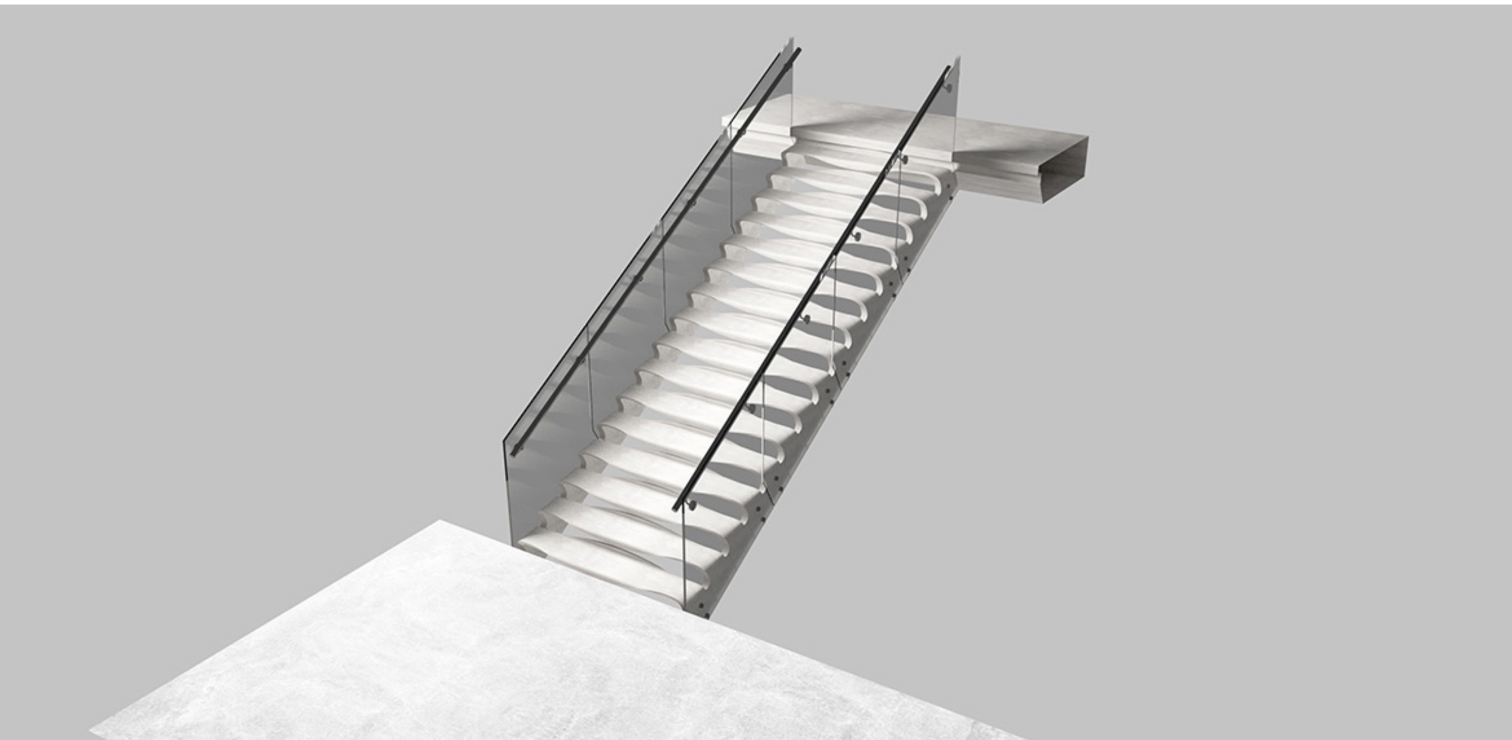
1ST PRICE OF THE STAIRS DESIGN AWARD COMPETITION

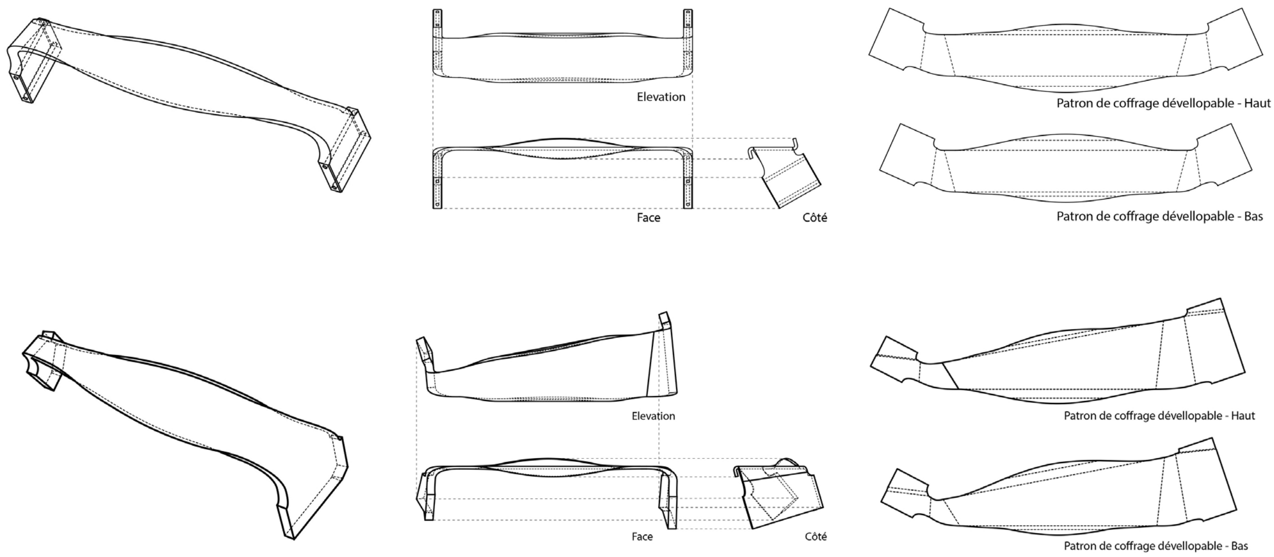
TEAM : CLÉMENT GOSSELIN &MADELEINE DEVINEAU
DATE : APRL 2019

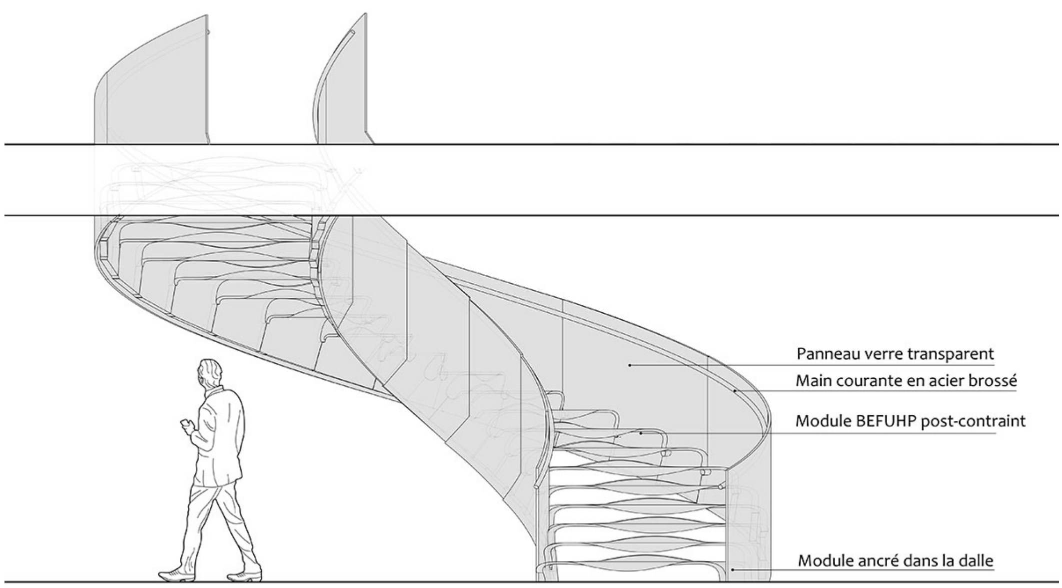
We designed a modular stair system made of ultra-high-performance fiber-reinforced concrete. One module is composed by one step. The assembly between the modules is realised by four post-tensioned cables through the stringers.
To deal with the fabrication constraints and the material performances, we worked on a sheet-based-shape, the thinner as possible, that we bend and fold to draw the steps the two stringers and the risers. The stair geometry is composed of developable surfaces to make the formwork base easily replaceable.

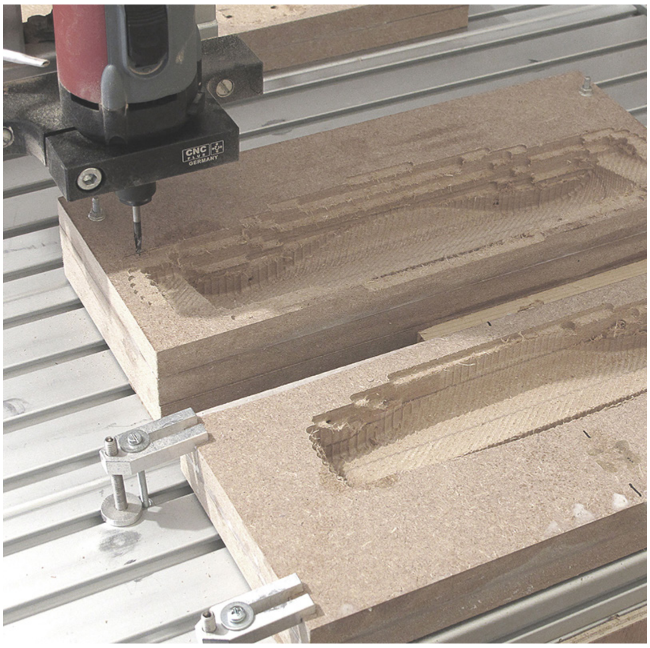


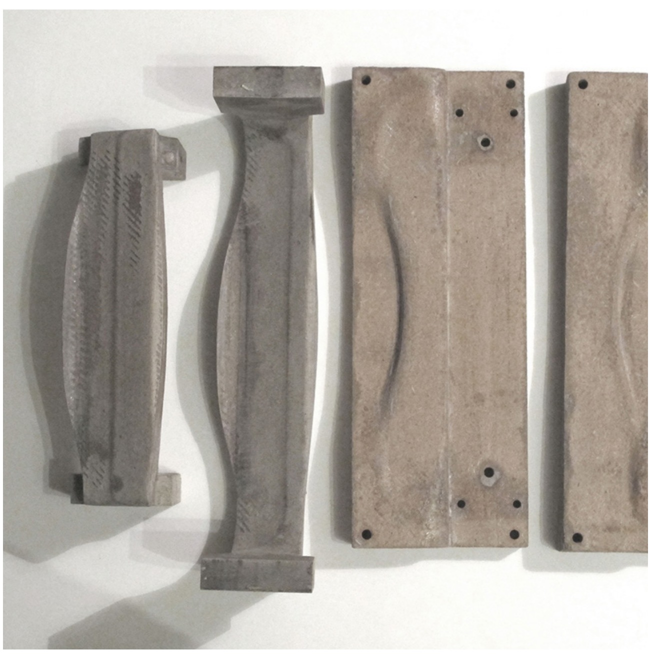


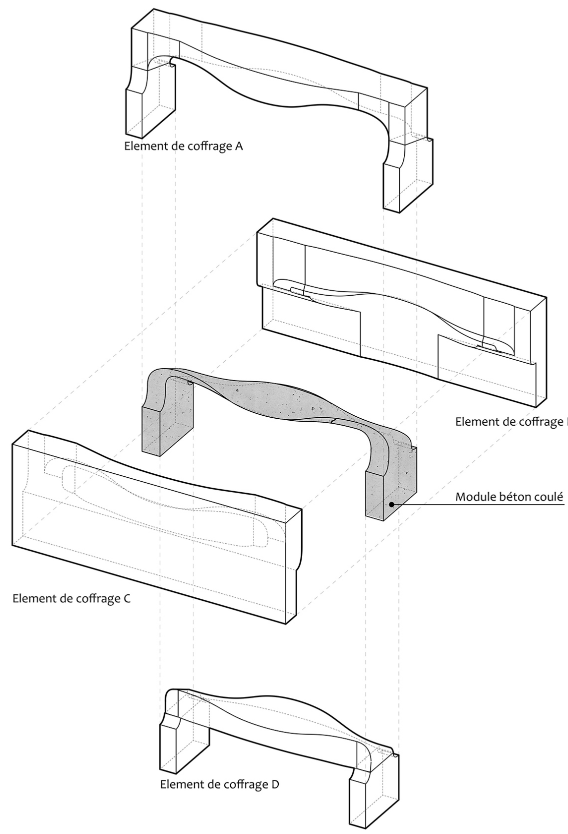



Elevation
Face
Côté
Patron de coffrage dévellopable - Haut
Patron de coffrage dévellopable - Bas
Elevation
Face
Côté
Patron de coffrage dévellopable - Haut
Patron de coffrage dévellopable - Bas


Panneau verre transparent
Main courante en acier brossé
Module BEFUHP post-contraint
Module ancré dans la dalle



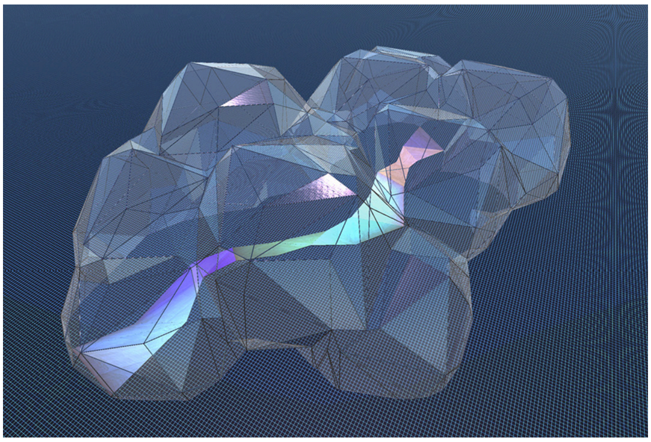


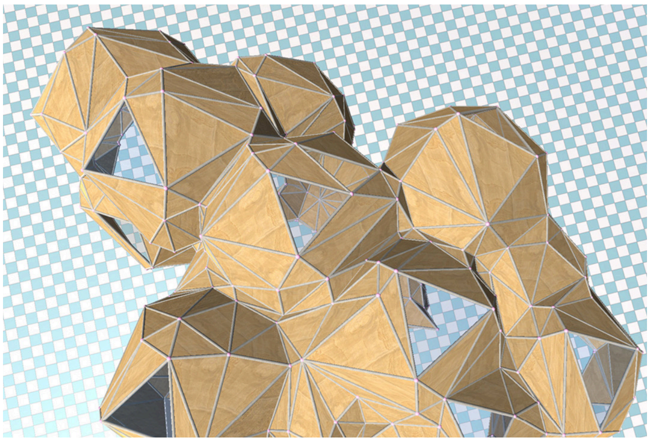

Element de coffrage A
Element de coffrage B
Module béton coulé
Element de coffrage C
Element de coffrage D

Teaching

WORKSHOP SEPTEMBRE 2016

UNIVERSITY : ENSA PARIS MALAQUAIS
TEACHER : CLÉMENT GOSSELIN
TEACHER ASSISTANT : LÉO DEMONT

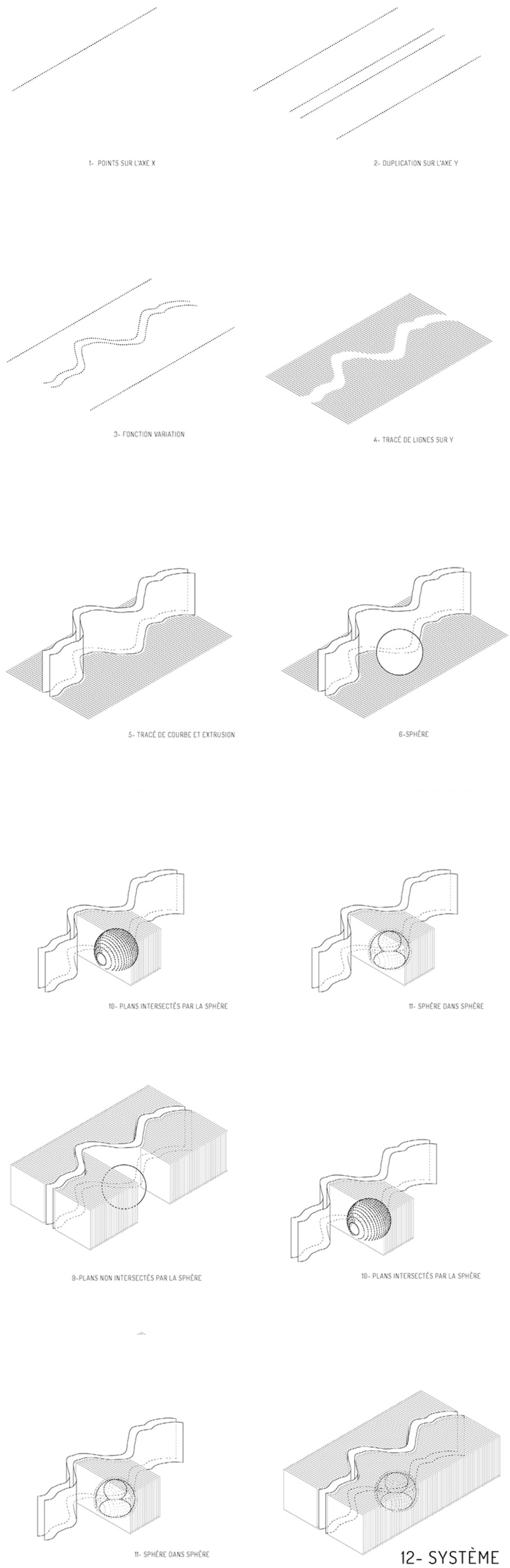


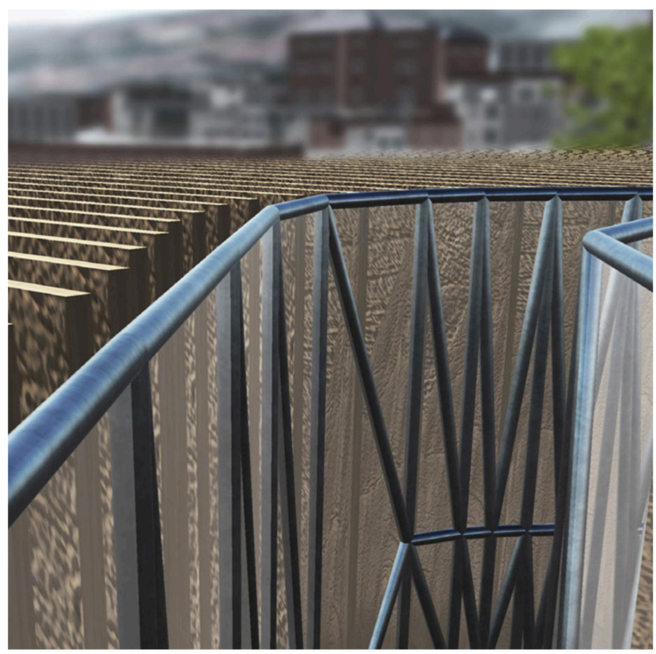


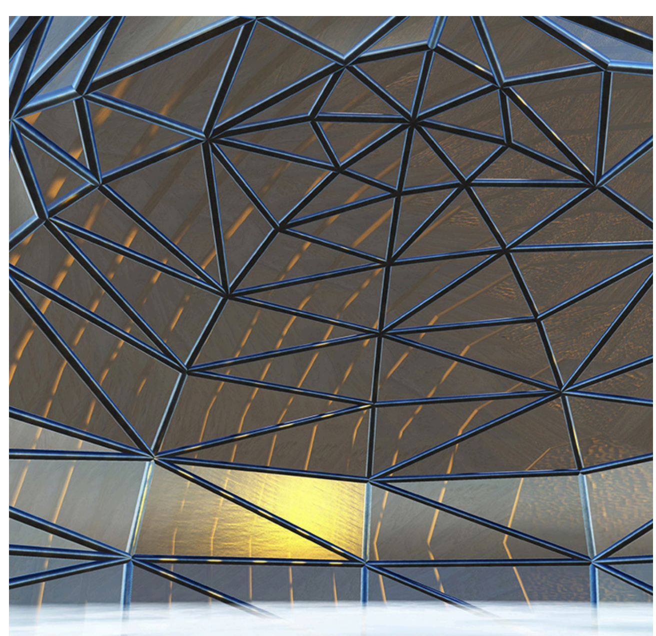
This was a one week workshop organised by the Digital Knowledge department. The workshop aims were to make an introduction to generative design and virtual reality by using Rhinoceros/Grasshopper and Dixie. The virtual reality was there used to visualised the project, but also to directly design with the helmet.

The students worked as a teams on a definition made with Grasshopper. They designed a shape at the architectural scale. The virtual reality allows them to understand the space atmosphere they created and then to modify the definition parameters to match their ideas in terms of scale materials and space morphology.

Students /
Aubin Tanguy, Benei Jade, Bou Salman Diana, Castel Louis, Copie Eléonore, de Matos Laura, Duboys Fresney Elisabeth, Fernandes Chamica Naide, Gaillard Gauthier, Ghiai-Chamlou Anahita, Grosman Clélia, Jami Guillaume, Khalife Margot, Lee Alice, Mahuzier Malo, Melobosis Emilie, Neron Héliance, Pham Van Pauline, Rolland Mélanie, Tisserand Guillaume.

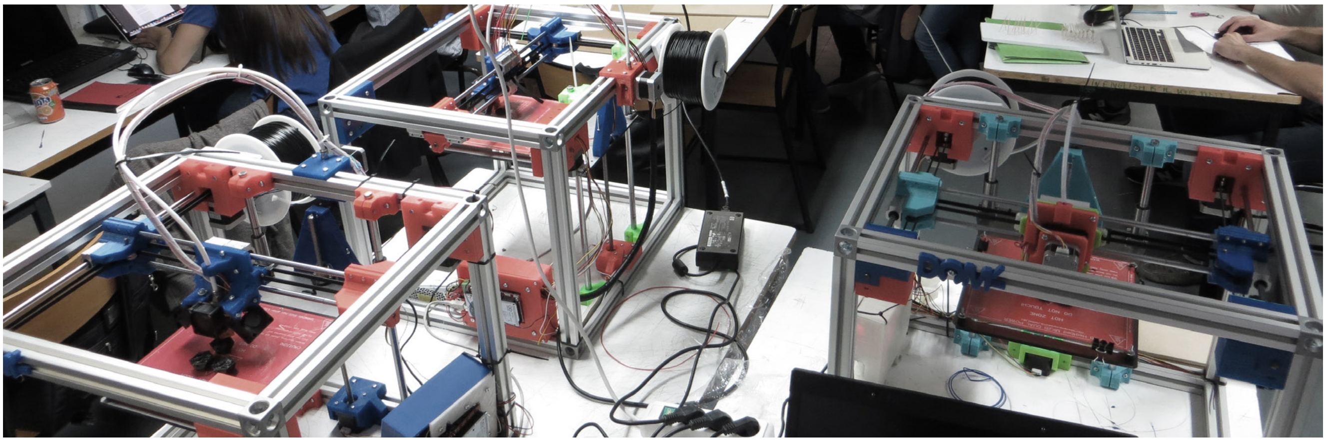

1- POINTS SUR L'AXE X
2- DUPLICATION SUR L'AXE Y
3- FONCTION VARIATION
4- TRACÉ DE LIGNES SUR Y
5- TRACÉ DE COURBE ET EXTRUSION
6-SPHÈRE
10- PLANS INTERSECTÉS PAR LA SPHÈRE
11- SPHÈRE DANS SPHÈRE
9-PLANS NON INTERSECTÉS PAR LA SPHÈRE
10- PLANS INTERSECTÉS PAR LA SPHÈRE
11- SPHÈRE DANS SPHÈRE
12- SYSTÈME



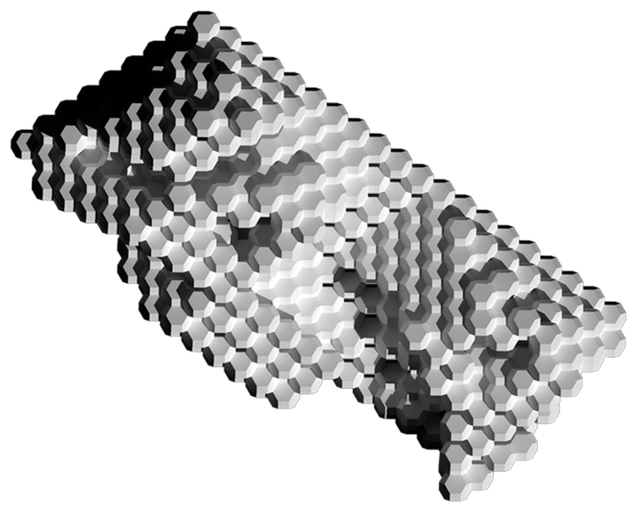


WORKSHOP, SEPTEMBRE 2014

UNIVERSITY : ENSA PARIS MALAQUAIS
TEACHER : NICOLQS LEDUC
TEACHER ASSISTANT : CLÉMENT GOSSELIN

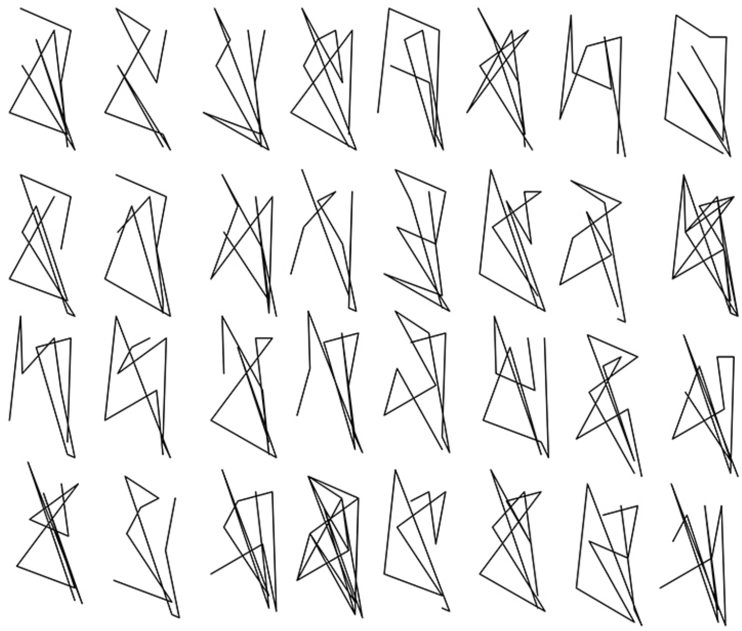


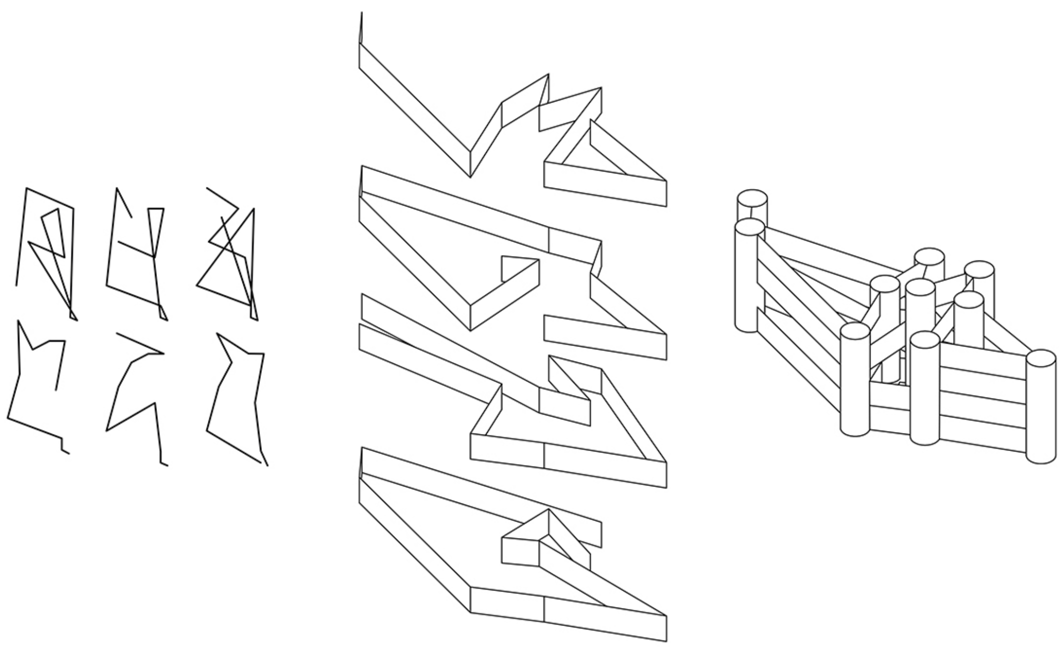
This was a one week workshop. Its aim was to introduce generative design to third year undergraduate students throughout a furniture design project, by using rhinoceros and Grasshopper. One of the project constraints was to include 3D printed elements (FDM, filament deposit manufacturing) in their projects. The students had to design their furniture by taking into account the specific constraint of this manufacturing process.

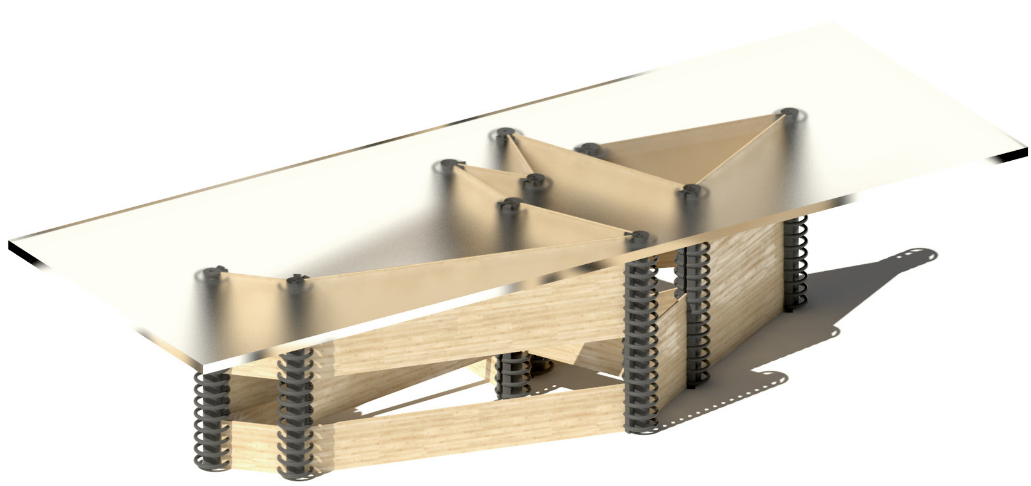


Students /
Ines Rodriguez, Mahriz Akhavan, Marie Chatin, Blandine Fauquet, Jérémy Moreuil, Jessica Gérard, Misoo Jung, Edouard De Lesquen, Marie Berneau, Olivier Rouanet, Anna Speakman, Alexandre Atamian, Léo Demont, Xiang Li.

This is a student project made using topological optimisation simulation with Kelvin cells and rhino/grasshopper.



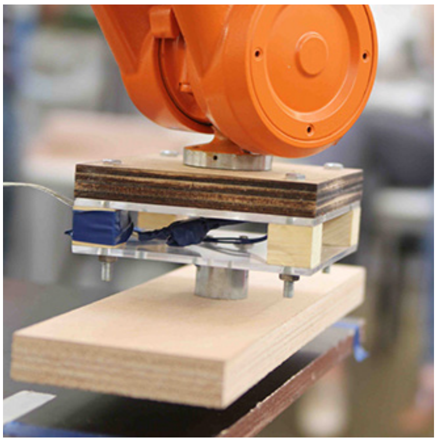
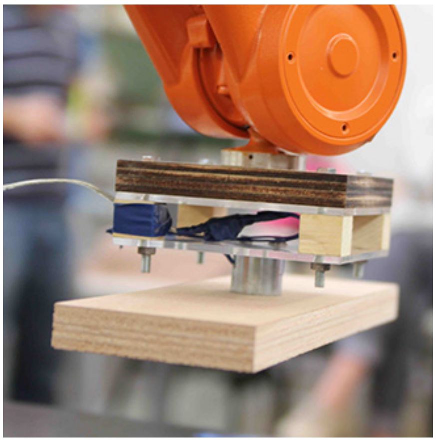




This is a student project made on an adaptation of the traveling salesman problem, using rhino/grasshopper and galapagos.

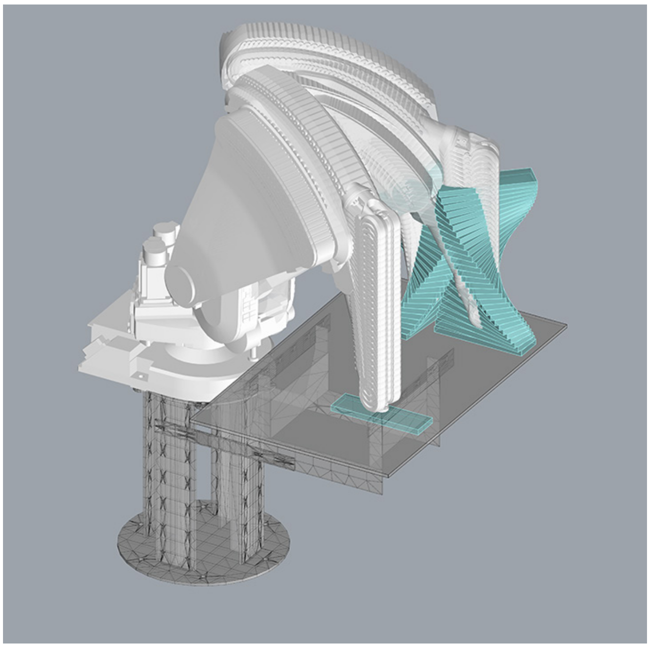
WORKSHOP ROBOTIC TOOL, SEPTEMBRE 2013

University : ENSA Paris Malaquais
Teacher : Félix Agid
Teacher assistant : Clément Gosselin, Mathieu Venot

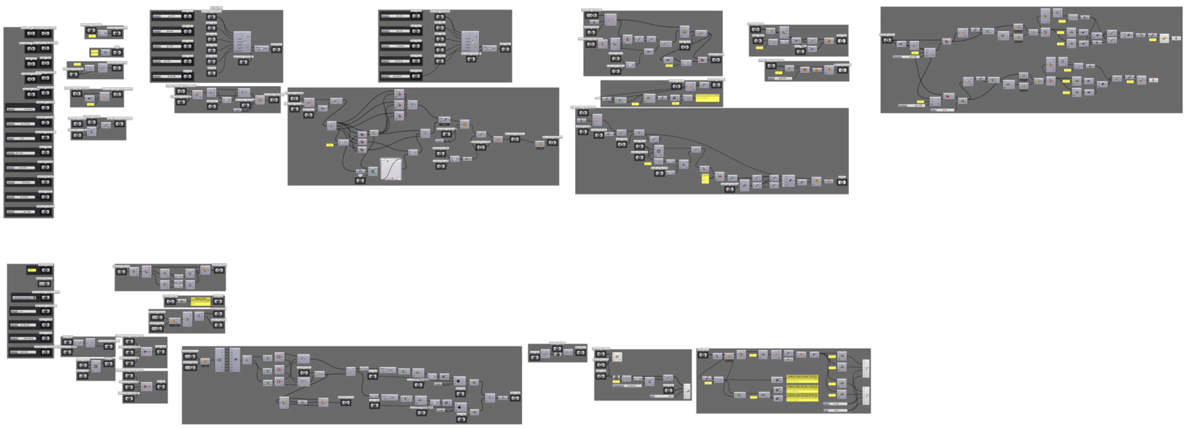
This workshop was part of the « Digital Design Literacy » workshops event organized in the ENSA Paris Malaquais by Pierre Cutellic, Maurizio Brocato, Christian Girard and Philippe Morel. This was a one week workshop. The objectives were to make an introduction to computer aided manufacturing (CAM) software. Tutorials were given on Rhino/grasshopper an Hall Robotics plug in. Each student group modeled and fabricated a tool adapted to fit on a 6 axes robot to create a manufacturing process. The exercise consisted to think a fabrication process in relation with their tool constraints, by programming the robot cinematic with simulation tool and then manufacture a prototype with it.

Students /
Marie Chevrier et Armelle Martin-Richon, Kim Yoona, Caroline Hug de Larauze & Nicolas Quiterie, Caroline Hug de Larauze & Nicolas Quiterie, Alieth Barbet, Nikola Jovanovic & Margaux Bullier, Manon Fichet, Ingrid Noual et Laure Lepigeon, Kubrusly Marcia, Corentin Morel & Nicolas Siffermann.



BUILDING THERMAL COURSE, 2016

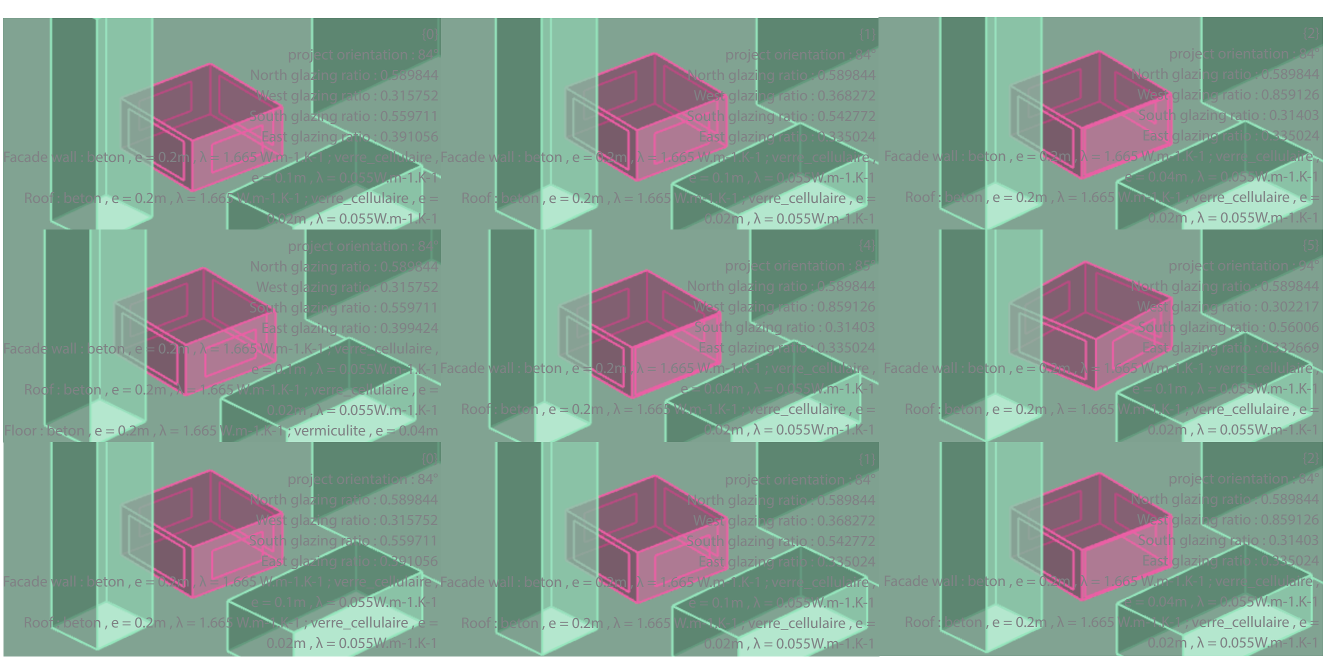
Place : ENSA Paris Malaquais
Supervisor : Robert Leroy
Teachers : Clément Gosselin, Roberta Zarcone.



It was a one term course about building thermal insulation simulation and optimisation for architects. This course included some basic thermal physic sessions and some exercises. We used Rhino, Grasshopper and its plugins Ladybug and Honeybee to work on thermal simulation and optimisation. The educational goal was to make understand the student that simulating software can be used as a design tool rather than post process engineer work.

One of the exercises was to undertake a multi objective optimisation for a simple box shaped project located in an urban environment. The project was geographically located to used weatherdata files. The optimisation objectives were : getting an energy consumption smaller than 50KWh/m²/year, getting an inside temperature always in the range of 18 to 27°C and minimised the insulated material used. The optimisation variables were the floor, the facade and the roof constitution, the windows thermal performances, the glazing ratio on each facade and the project orientation. To realized the optimisation we used a GA-based algorithm (here we used Octopus grasshopper plugin).

Students /
Ian Shackleford, Paul-Louis Spiral, Hugo Suchet, Abla Tahri, Santiago Tamayo, Louisa Thanopoulou, Guillaume Tisserand, Dora Tzvetanov, Lua Vadaine, Elsa Valax, Hélène Van Hamme, François Vasseur, Florent Verdes, Hugues, Villiaumey, Marcelline Viltard, Sarah Vinckel, Marie Werbrouck, Clara Yammine, Xinyu Yan, Maria Yared, Hanyue Zhang, Axelle Zibi



Academic project

DIPLOMA PROJECT

ENSA Paris Malaquais
Master 2 semester 2
Teacher : Philippe Morel, Jean Aimé Shu
Student : Clément Gosselin

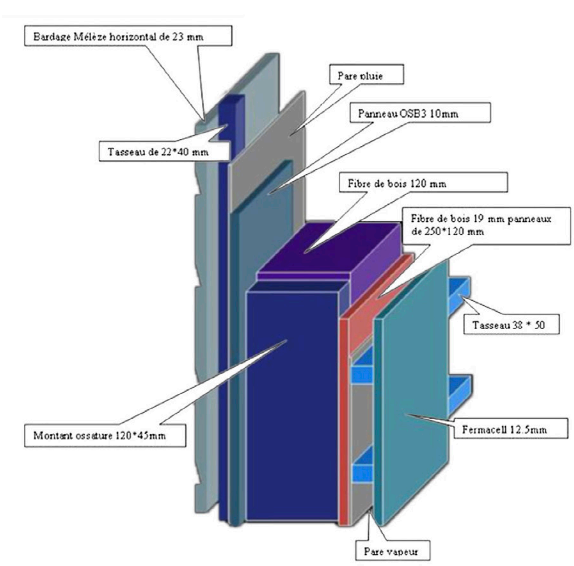
I worked for three years on an experimental research project about large scale additive manufacturing of cimentitious graded material from design to manufacture. I began to work on this subject during my first master term. It became gradually a team project. I led the research all along my master. During my final project I continued to work on this subject in the framework of a research project funded with the DEMOCRITE symposium with as partnership the ENSAPM, the ENSAM, the PIM, Hal Robotics and LafargeHolcime. This work led to several articles : Additive manufacturing and multi-objective optimization of graded polystyrene aggregate concrete structures , Design Modeling Symposium, Springer, 2015 and Large-scale 3D printing of ultra-high performance concrete - a new processing route for architects and builders Material and design 2016. The last one came out of the research project founded by the DEMOCRITE symposium.

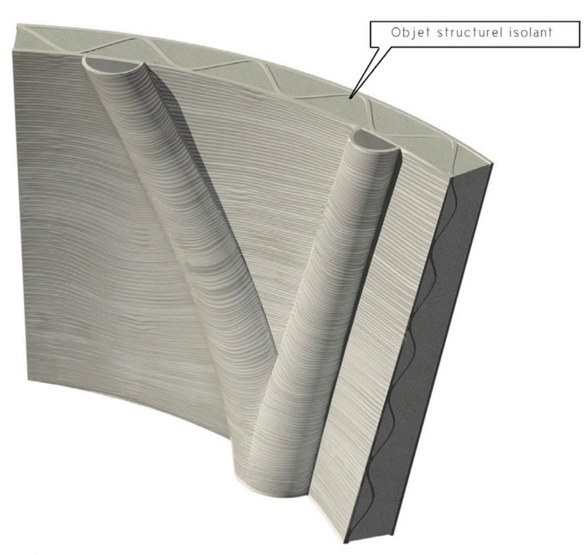
Additive manufacturing technologies are today an important topic in the scientific field. Any kind of material can be printed (ceramic, metal, polymer, even organic cells). However, most of the technologies are made to manufacture small or medium scale object. Today there are no fully fonctionnal additive manufacturing technologies to build an architectural scale object. Few research about large scale additive manufacturing are being developped sine the end of the 20st century. The most interesting of them are D-shape and Contour Crafting. Since the first building prototypes were made in 2015 by the WinSun company in China lot of research programs on this subject have been created.

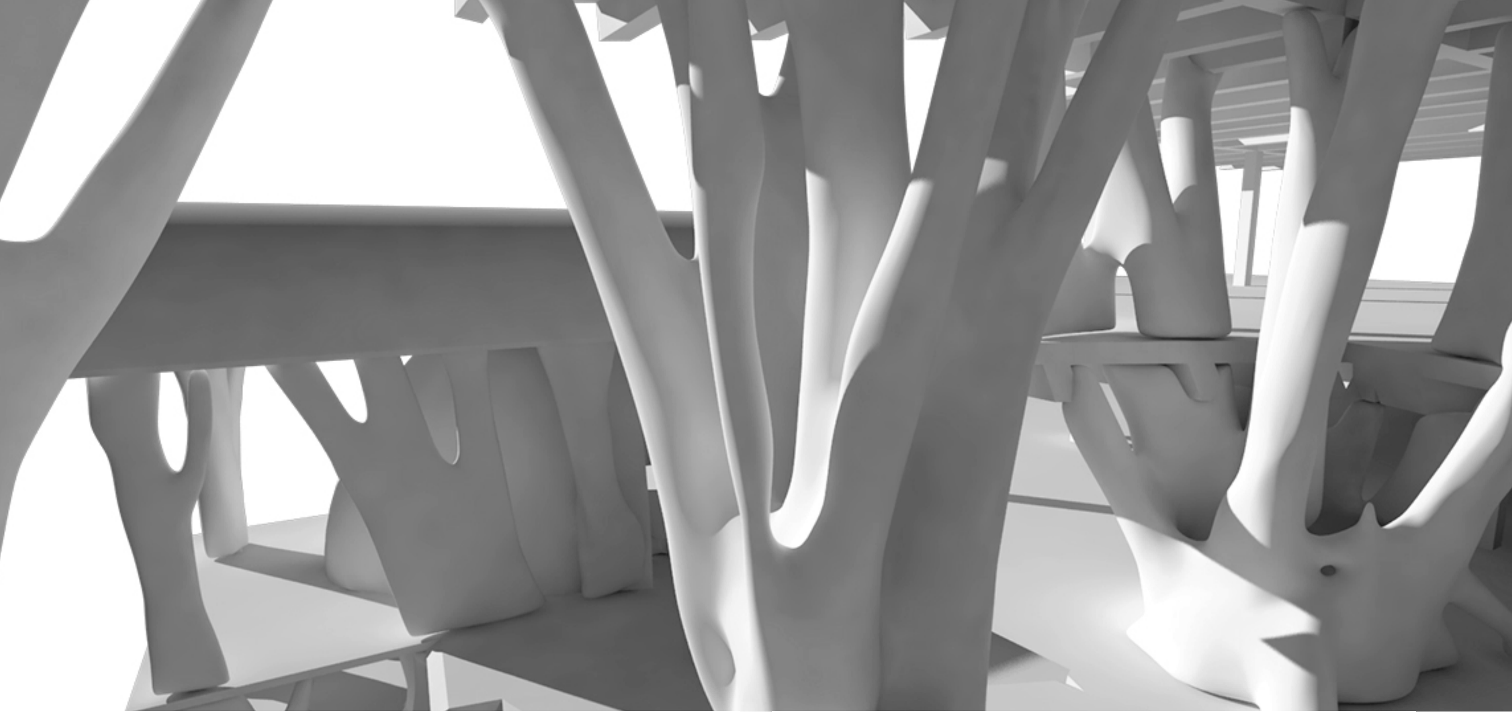
Most of the researches on additive manufacturing are focused on fabrication technologies. There are even a few research investigations about developing large scale specific designing methods to generate advance geometry that takes into account the manufacturing constraints. Indeed, we can't use computer aided drawing software to design 3D printed projects. We need to use computer aided design software to use all the potential of this manufacturing process. The material feature and the manufacturing constraints entail non-standard and complex shapes that can't be drawn in computer aided drawing software. With computer aided design softwares we can create a project in relation with constraints by using the simulation tools.

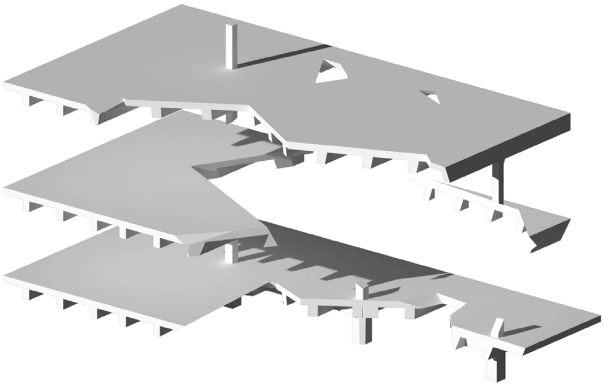
Additive manufacturing redefines the boundaries of the architectural elements. With this manufacturing process, there is no need to to divide the building in layers in relation to the specialist worker succession (structural wall, insolating material, facade). A synergy can be created between the different building organs that could create a new architectural element topology. Thus, this manufacturing process entails an integrative approach of the knowledge used during the design of the architectural project.

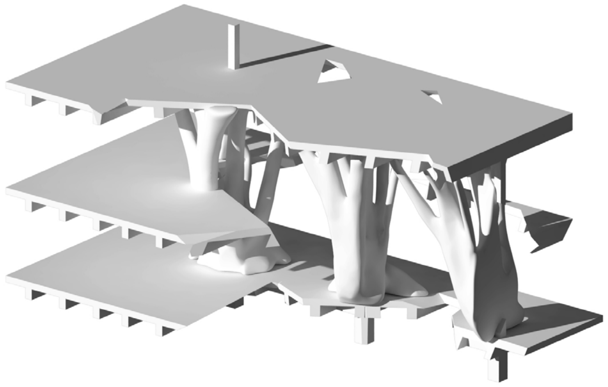
This work is about « design to manufacture » adapted to architectural scale additive manufacturing throughout a cross-disciplinary approach. The objective was to design, optimised and manufacture architectural element prototypes in relation to architectural design, technical performances and manufacturing process. Generate an optimised geometry for additive manufacturing is a complex work because the performances of a 3D printed object depend on 3 scale levels : the material properties, the tool-path deposition and the global morphology. Each one of them needs to











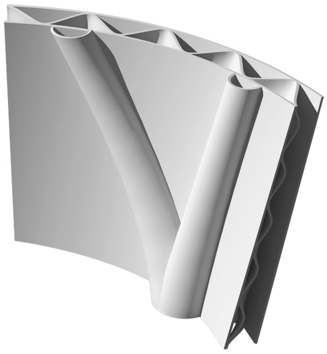
be optimised in relation with the others.

I studied several aspects of this topic: the additive manufacturing process, the material formulation, the mechanical properties, the tool-path strategies and the morphology optimisation. I will now introduce briefly each one of those subjects.

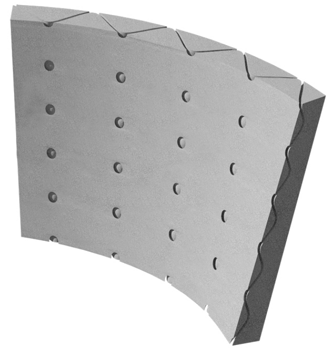
About the additive manufacturing process. There is for now no industrial operational turnkey solution. That is why I worked on a specific selective deposition manufacturing process. Indeed, that type of additive manufacturing process is more efficient for large scale object than selective solidification process. It was adapted to cementicious material. This process was thought to achieve graded performance material printing from structural to insolated material.
This process consists of two steps. First a mortar premix is prepared with reological behavior appropriate for pumping. At this stage the material has a small granulometry distribution, a low plastic yield value, a long setting time and be the less thixotrop as possible. Then this premix is pumped to a printing head were several additives are added to the mixture to increase the plastic yield value, reduce the setting time and increase the thixotropie material properties. Otherwise, other specific additives can be added to change the material performance. In this work some tests were made with light aggregates (polystyrene beads) to change the material performance from structural to insulated material.

About the material formulation. I successively work with two different companies about the material formulation. I first worked with Chryso during the first three master's terms (it was a non formal collaboration). Then, with Lafarge/Holcime in the framework of the research project funded with the DEMOCRIT symposium. For this research project LafargeHolcim developed a formulation adapted to additive manufacturing. The formulation derived from ultra high performance concrete (UHPC) (even if depending on the very small granulometry, this must be defined as a mortar). Therefore, it contains silica fume, a very low E/C (<0,1). Otherwise, it is optimised for the manufacturing process described above.. It has a long workability time and is composed of a specific polymer-base resin to reduce the structural interface issues between layers.

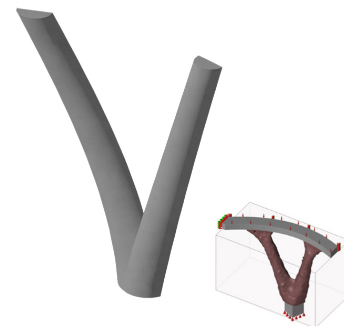
About the mechanical properties. Two specimens series were tested. The first serie was made with Chryso material for my master thesis. It was a compression test on cylindrical specimen. This test was made to compare poured mortar against printed mortar and also to determine the relation between the the tool-path and the material performance and fracture feature. The compressive resistance of printed specimen is roughly 40% less important than the poured specimen one and the fracture failure is directly linked to the tool-path.



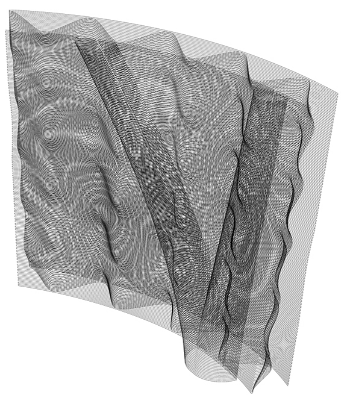
The printed loosed formwork



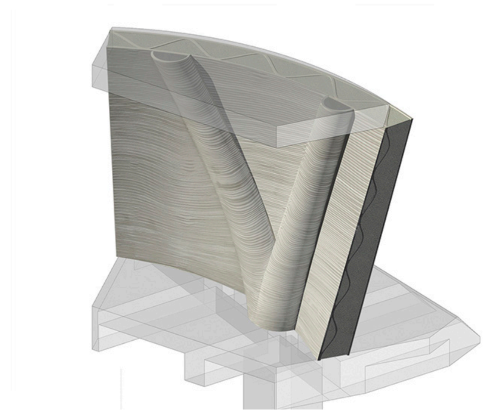
The poured insulated concrete



The structural insulated concrete



The toolpath



The final architectural element

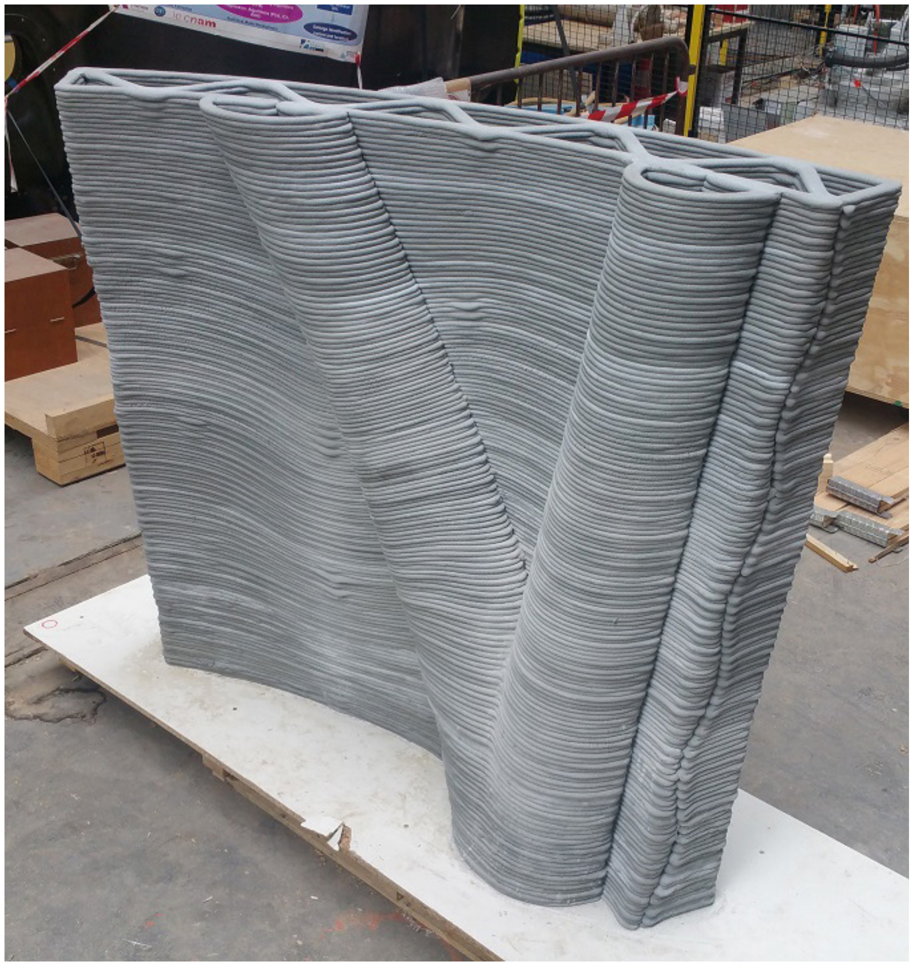
Printed mortar has a pseudo ductile failure method (it is not brittle as the poured mortar). The second test serie was made with lafargeholcime material. It was a flexion test to compare poured mortar against printed mortar. There was only a 10% difference between the structural performances of the two groups of samples .

About the tool-path strategies. The classical slicer software we can use for polymer 3D printing are not adapted to large scale objects. Indeed, those slicing methods consist of planar layers constituted of one or several boundary laces and a filling lace pattern. Otherwise, because we are dealing with planar layers the objects produce with this method can be compared to corbel structures, which is one of the less efficient structure typology because it make the laces work with flexion and, in some case, the interfaces work with traction. To create a tool-path method adapted to large scale object we have to orient the laces in the three dimensions. This can be done by using the layering anisotropy to optimise the behavior of printed structure. The layer interfaces are the week structural point. The best orientation for those interfaces is to constrain them in compression. However the laces work fine with traction, especially if we are dealing with a fiber-reinforced mateial. To design an object that takes into account those constraints, we needed to generate a 3D tool-path which is totally different than classical planar layering methods.

About the morphology optimisations. I worked with two engineers on a GA-based multi objective optimisation algorithm. It was designed to optimised the repartition of several materials depending on their properties. Basically, we were working on an algorithm that can optimise the distribution of structural and insulated material depending on the specific boundary constraint (thermal and load constraints). This algorithm was not taking additive manufacturing constraints into account.

During my last term project, we chose to work on a case study of a reconstruction project where the existing structure is extremely damaged. The reason of this choice was to work with a contrained environment. Indeed, that kind of existing environment is a huge constraint that requires complex non-standard architectural éléments. The idea was to design a project made to be built with large scale additive manufacturing of cementitious material and produces a scale 1:1 architectural element. This design project took into account all the research introduced above about the manufacturing process, the material formulation, the mechanical properties, the tool-path 3D strategies and the morphology optimisation.

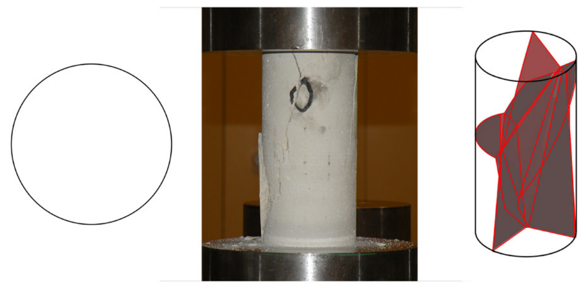
The architectural element produce was a loosed formwork. It is constituted of two parts : one made to receive poured structural mortar and one made to received poured insulated mortar. The structural part is designed in relation to a specific load. The insulated part is designed to reduce thermal bridges. The tool-path is generated to orient the lace interfaces perpendicular to the compression stress.



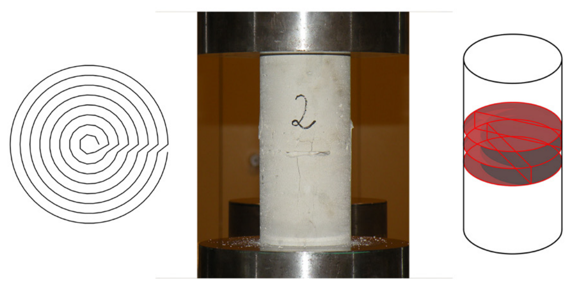
MASTER THESIS

ENSA Paris Malaquais
Master 2 semester 1
Teacher : Robert Le Roy
Student : Clément Gosselin

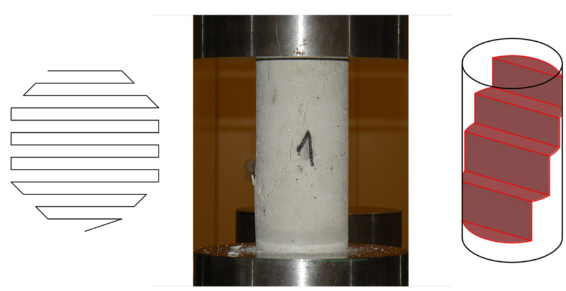
My master thesis also focused on large scale additive manufacturing process of cementitious material. This was a scientific work that contains a series of research and experiment about that focused on cementitious material adapted to additive manufacturing process. The following thematics were approached : cementitious material formulation, rheological characterization, mechanical evolution across time of young age cementitious material, mechanical performance characterization.



Thus, compression mechanical tests were realized on cylindrical specimen to characterize two things: the different about mechanical performance between poured and printed mortar and the impact of the toolpath, whether the laces orientation, on the mechanical performances and the fracture method of printed objects. The experiment consisted of realizing three cylindrical specimens made to be tested in compression. One poured mortar specimen and two printed mortar specimens, each of them with a different toolpath. One was realized with an orthogonal toolpath and the other with a concentric one.

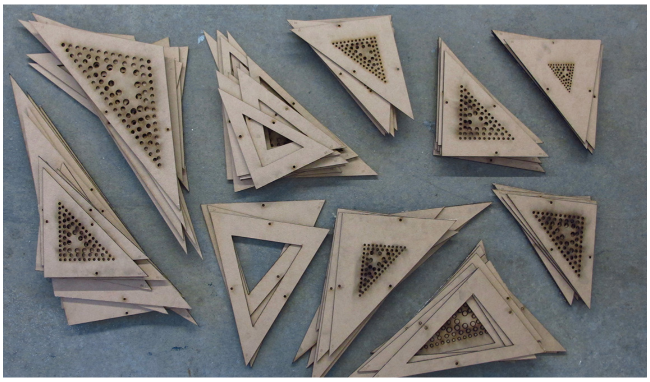


A part of this work was published in the article Additive manufacturing and multi-objective optimization of graded polystyrene aggregate concrete structures, Design Modeling Symposium, springer 2015.

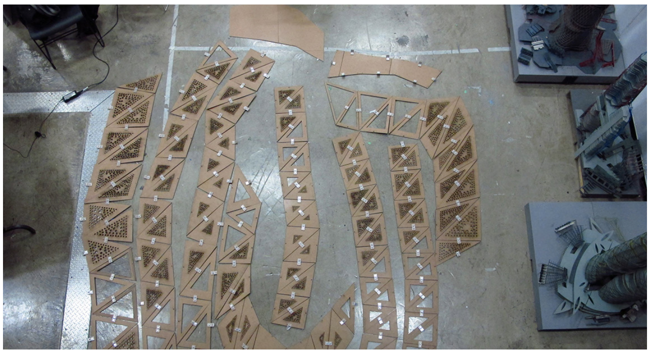


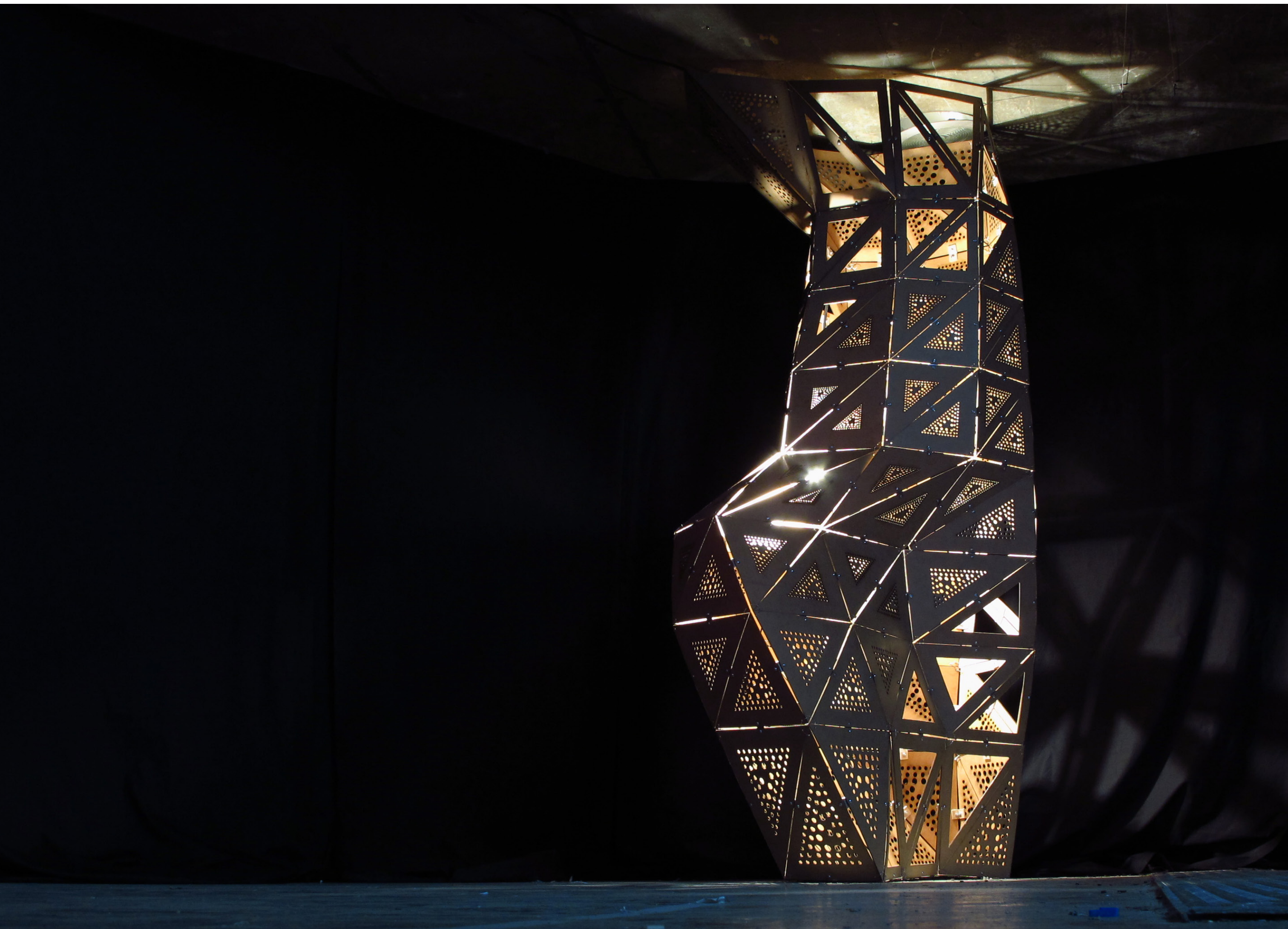
PARAMETRIC FABRICATION

Carleton university, Ottawa
Master 2 semester 1
Teacher : Johan Voordouw
Students : Ryan Fogarty, Clément Gosselin, Hanson Mak, Ekaterina Tchoupriko



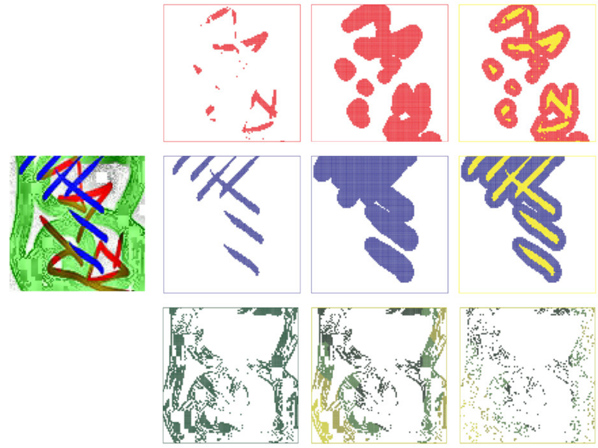
This was a two weeks workshop. The aim was to design and fabricate a furniture scale project by using parametric tools with a high intrication level. The design was realise with Rhino and Grasshopper software. The main difficulty was to realise a unique assembly that can be used to connect all the panels no matter the variation of the relative angle between the panels.





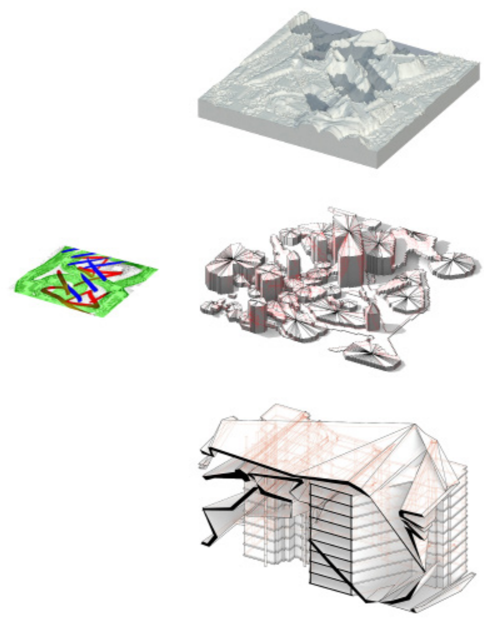
MACHINE VISION

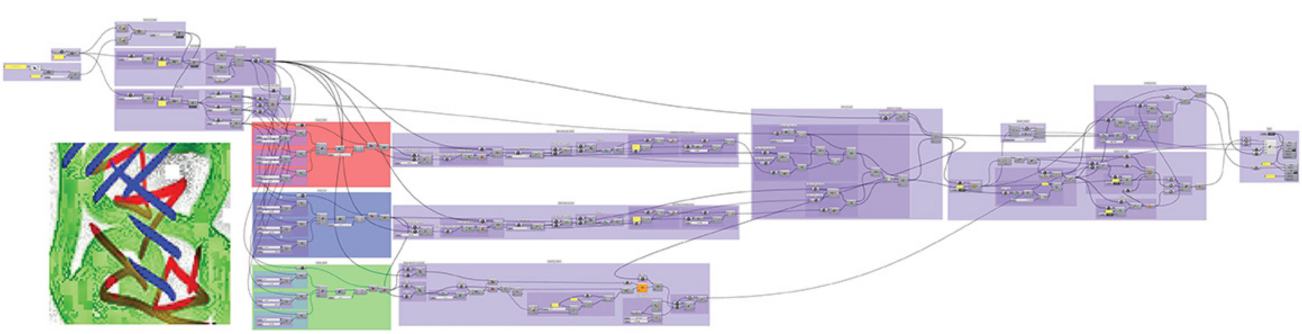
ENSA Paris Malaquais
Undergrad Senior Year 2dn Semester
Teacher : Félix Agid
Teacher Assistant: Tristant Gobin
Students: Clément Gosselin, Paul Poinet, Mathieux Venot

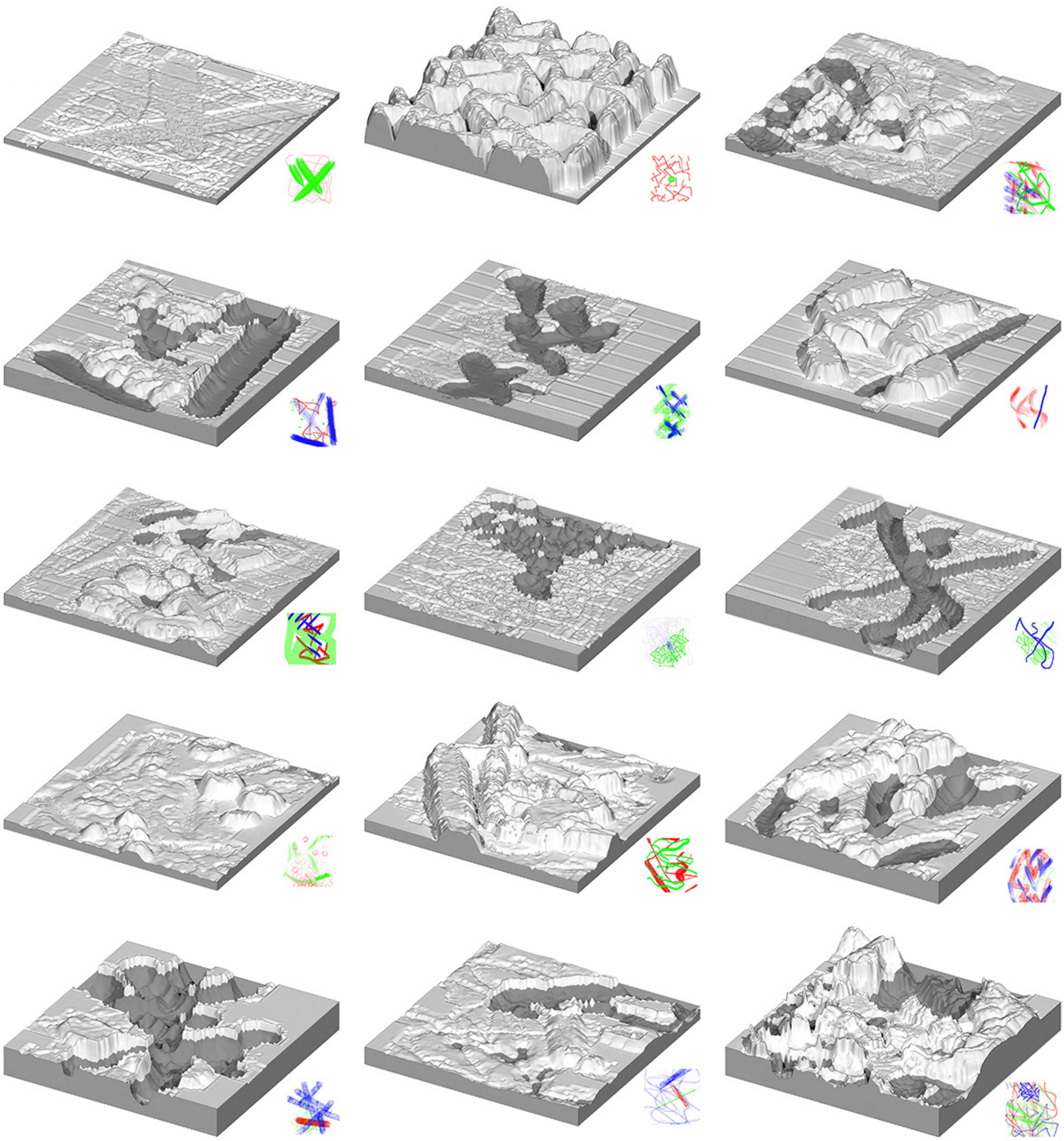


The workshop goal was to create an experimental protocol that generates an architectural design thought the analyse of the intrinsic data of a territory by using industrial machine vision tools (Robotrealm). This workshop contains introduction lectures about machine vision. We studied basic picture algorithm applied to robotic.

Our work was about the automation of picture interpretation. We first create a collection of 50 discrete pictures that follows rigorous drawing rules. Those rules were about colors (green, red and blue), drawing shapes (dots, single line, polyline, curves...) and tool thickness. Each of those drawings were then processed through an algorithm as a territory map at three different scales : the landscape, the city and the building.

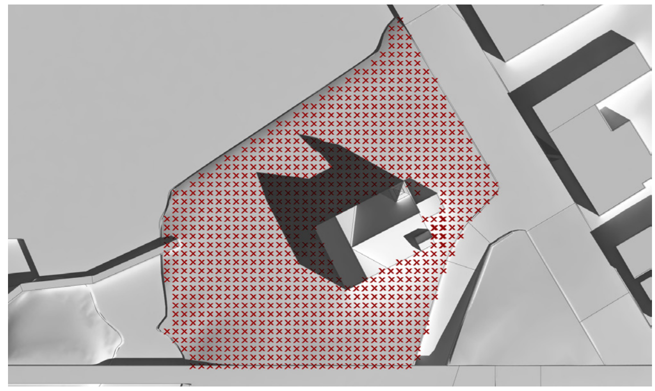






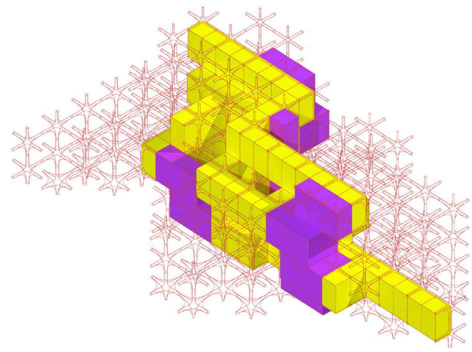
RESEARCH CENTER IN ALMONT, CANADA

Carlton University Ottawa, Canada
Undergraduate Senior Year 1st Semester
Teacher : Inderbear Riar
Student : Clément Gosselin

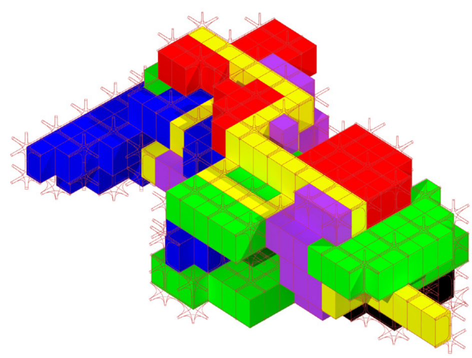


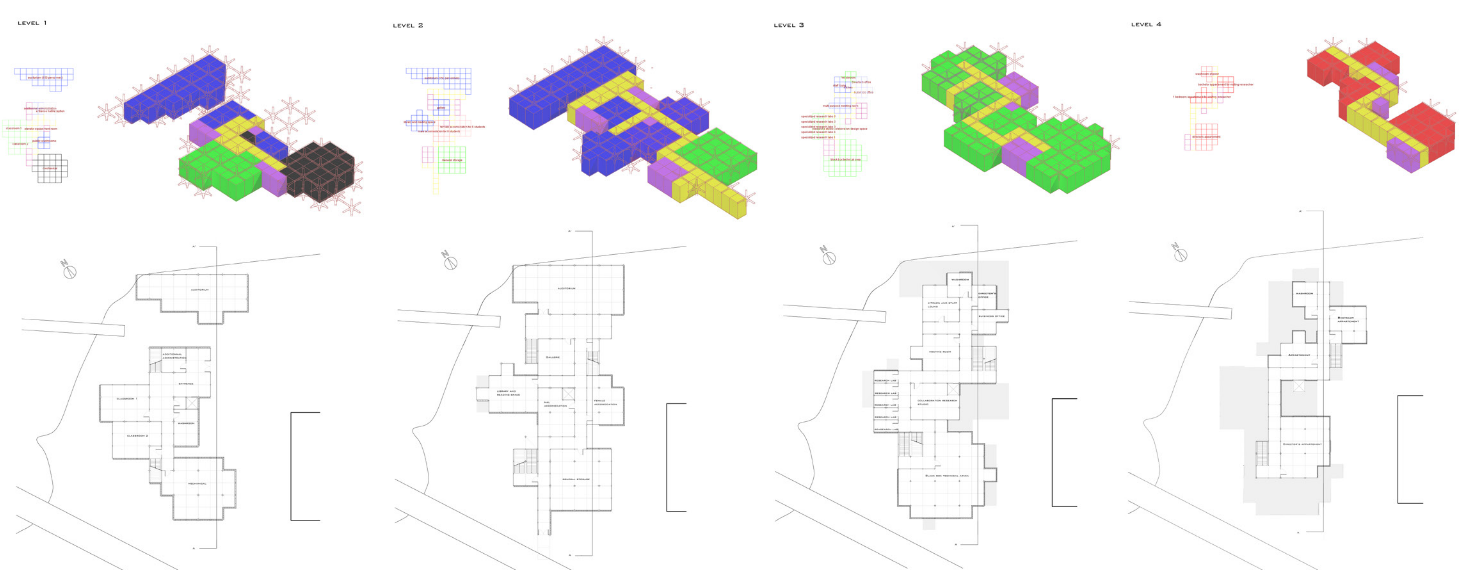
This is an experimental project that was entirely designed with Grasshopper software. The design is the result of the application of a series of boolean rules. Those rules make an algorithm which is defined with a programming language.

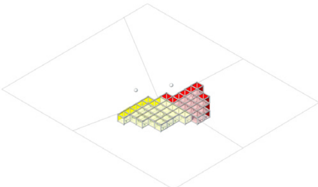
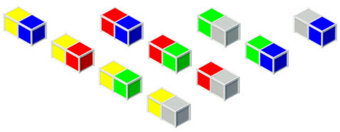
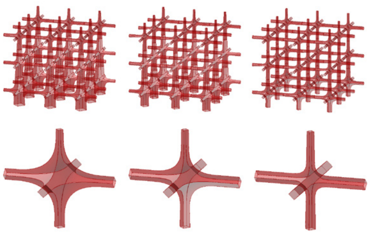
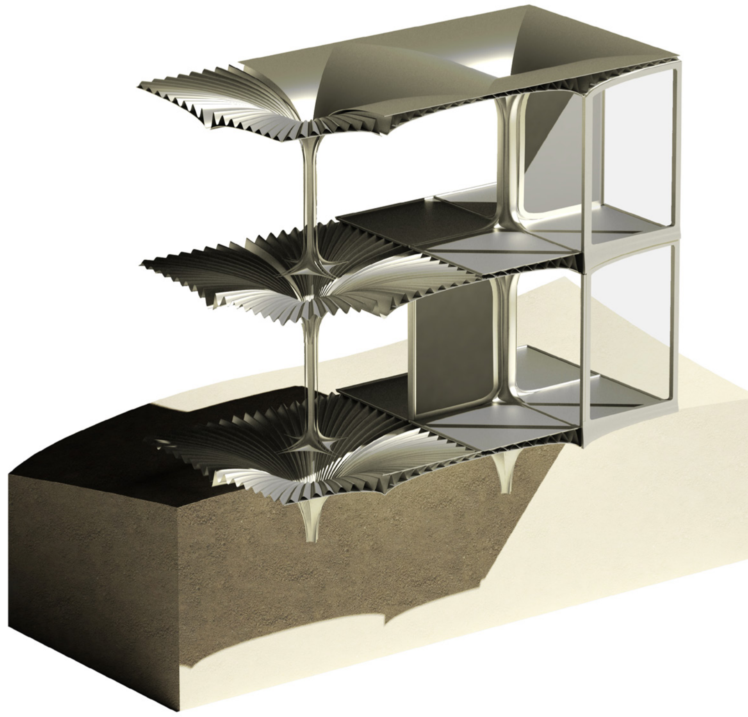
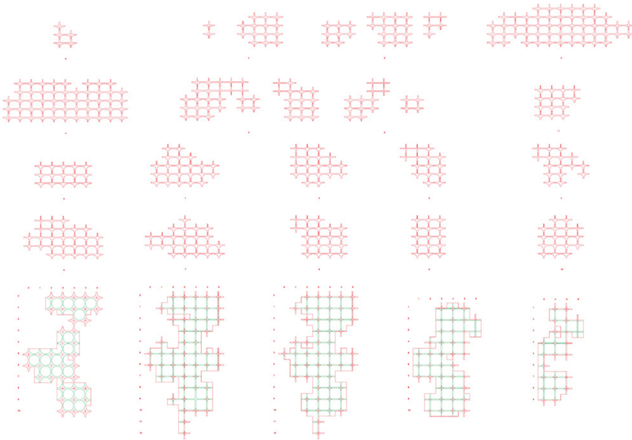
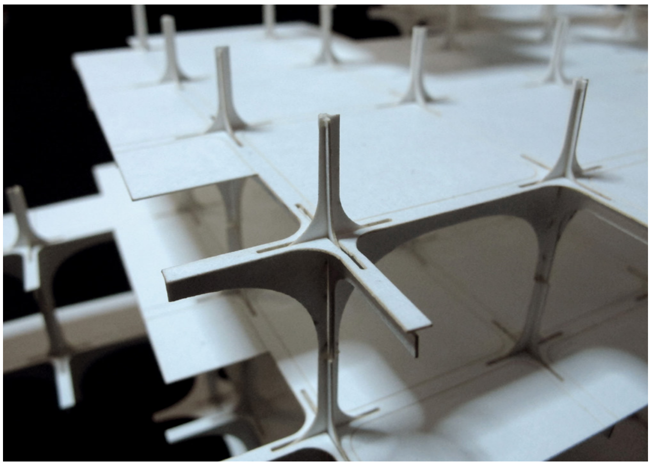
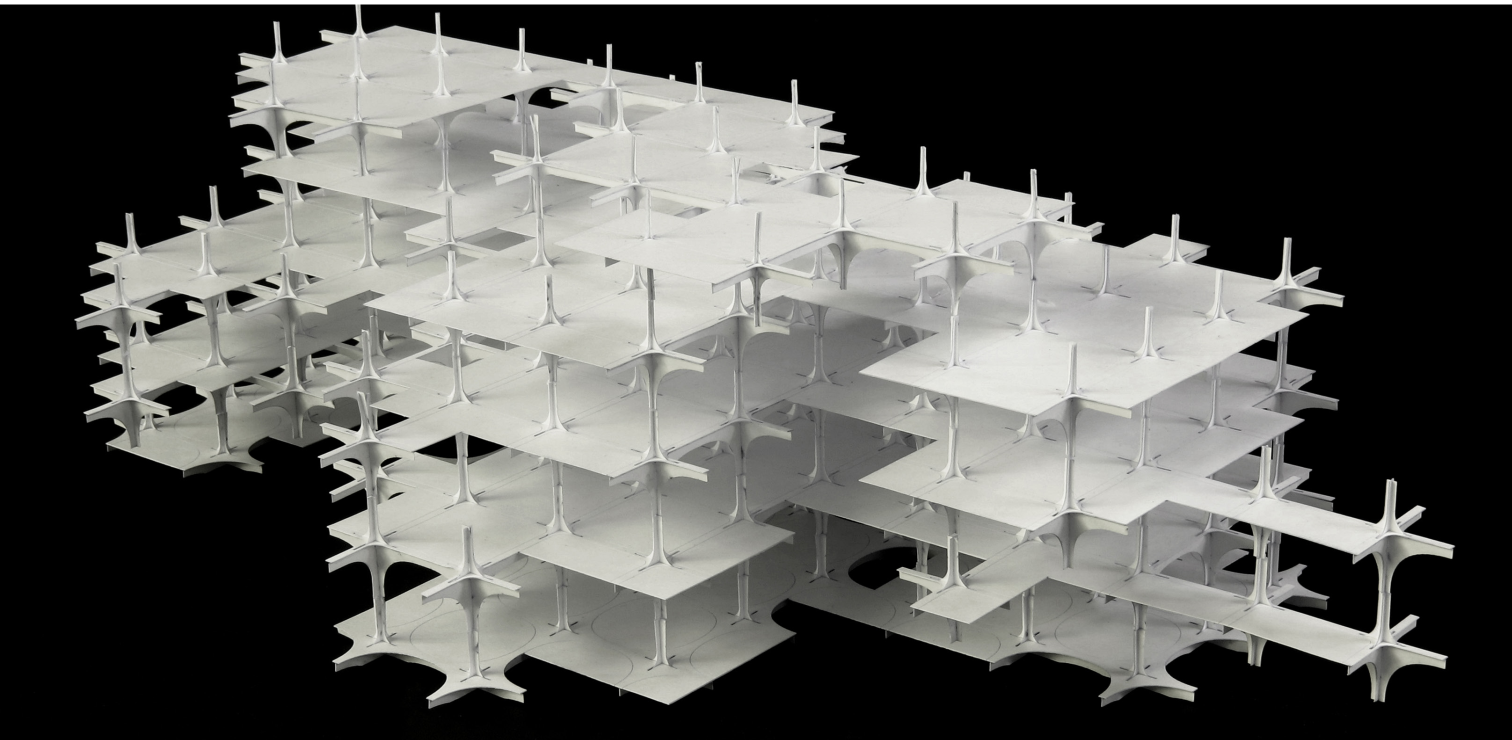
There are three main definitions in the project: the space, the program and the structure.
_The space is discretizes by a 3D regular grid of points which are the potential position of voxels (space unites).
_Each part of the program is defined by a gathering of voxel that follow repartition rules depending on the type of the space.
_The structure is intricate to the space unite repartition: it is composed by parametric modules. They follow functions that optimized the shape of the structure depending on the position of the spaces unites.



Hence those rules, the building can evolve and growing up according to the needs. Because the building shape is complex the entire building could be 3D print with robot including in its design (the building could be built by itself). To make the building evolve, you just define the space unit you want to add, then the software adjusts the structure to build it, and then robots actualize the structure by 3D printing the new space.

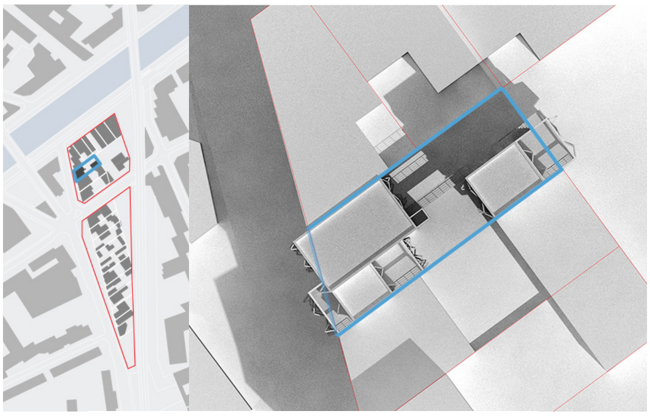


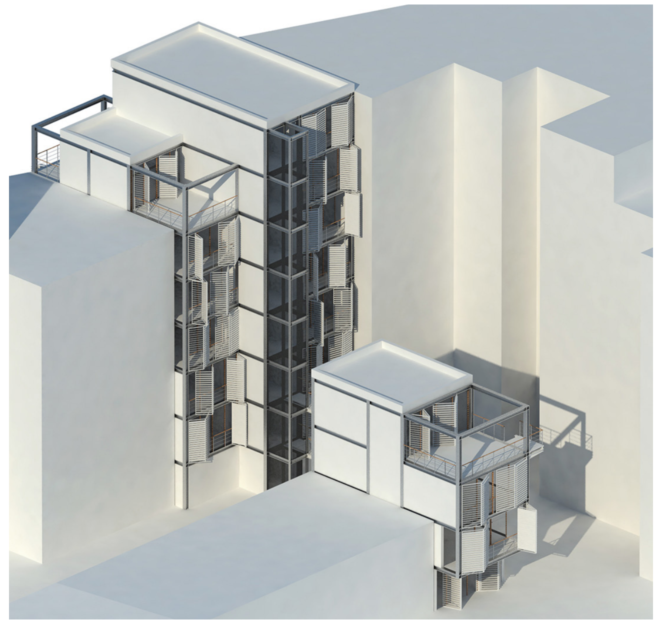


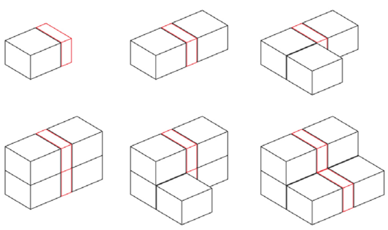








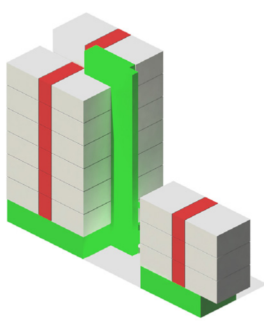
MODULAR HOUSING

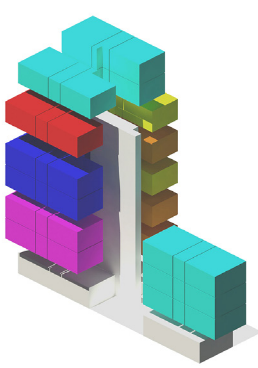
ENSA Paris Malaquais
Licence 2 semester 2
Teacher : Jean Léonard
Student : Clément Gosselin

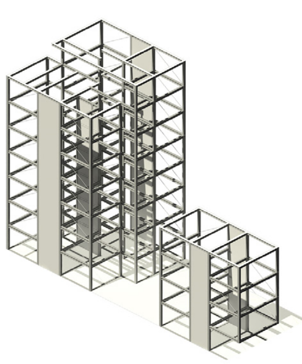












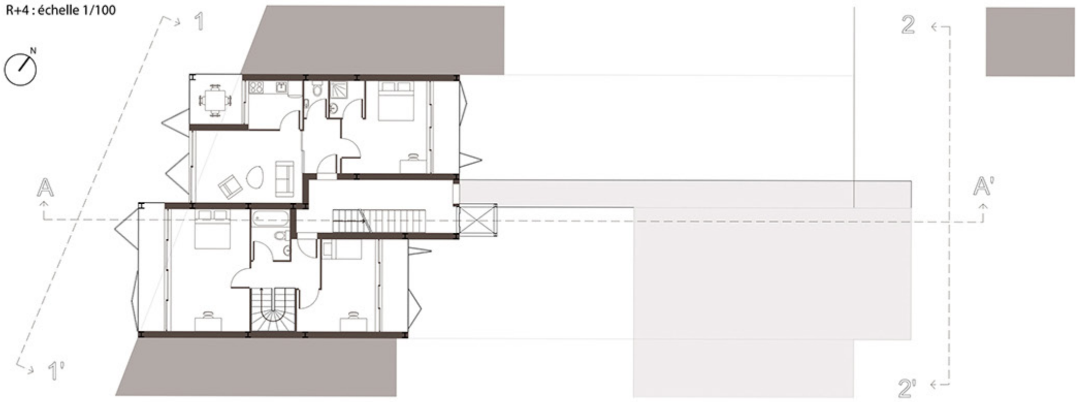
This is a housing project located in Paris, close to the Canal de l'Ourcq. It is a 11 housing project. There is only one vertical circulation that link the two building bodies.

The apartments organisation are based on a modular system that allow a good flexibility in terms of arrangement and sizes. The modular system is composed by two différent kinds of modules : the technical module and the space module. Each technical module link up to two space module. It contains all the technical flows (water, electricity, optic fiber...) and the technical spaces (rooms dependant to sewage disposal and the circulations). The central position of the technical equipments in the building allows a great flexibility to arrange the apartments. The space modules can be arranged with any kind of spaces.

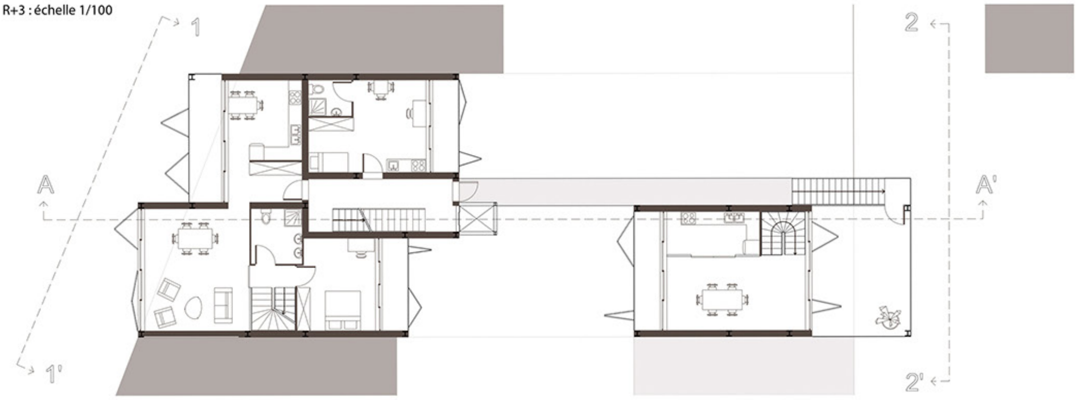
The modular system allows a great diversity in terms of apartment size. Thus the building has : 2 apartments with 1 module, 3 apartments with 2 modules, 1 apartment with 3 modules, 1 apartment with 4 modules, 1 apartment with 5 modules, 2 apartments with 6 modules.

The structure is parallel to the main direction of the plot to maximise the light exposure of the apartments.

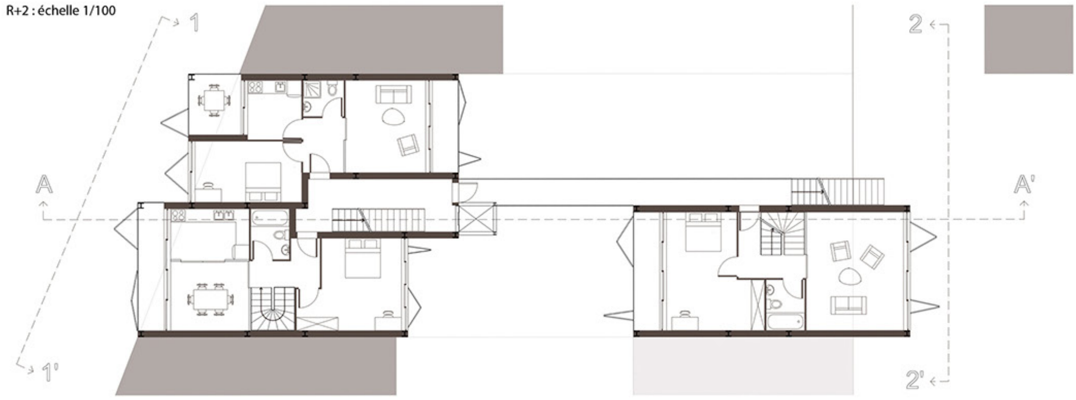
R+4 : échelle 1/100



R+3 : échelle 1/100



R+2 : échelle 1/100



RDC : échelle 1/100