

The GenDes1.0 Experiment
object oriented architecture

Museum of Modern Art, Athens

Report (with pictures)

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Introduction and Intentions for GenDes1.0

This project is the summary of 2 years of interest in the field of generative architecture. It is not the intention to design a beautiful building this time. The primary intention of the project, is to iron out all the little problems that currently make a true generative architecture seem very far away. Learning from previous experiments (i.e. 4PS2+1PC) the machine element of the generative process is designed to be passive, to function as an empowering tool to the designer, **it is not designed to replace the human designer**, instead to create a symbiotic relationship between the designer and technology. The idea of the project, is to develop and test a series of passive, intelligent architecturally legible objects that a human designer can use to create a design for a building quickly, whilst empowering them to make complex design manoeuvres. Specifically, the tools are intended to;

Create **Site Responsive Generative Architecture**

This means that the created architecture should respond to its site in real time, The aim of the project is to establish a data structure flexible enough to allow for this to happen.

Create **Object Oriented Architecture**

The primary intention of this study is to create spaces that during the design are spatially aware of their position in a building in relation to their neighbouring spaces and objects. All objects have good manners, they and know who to talk, who to listen to and when. This will avoid any data flow confusions.

Create **Intelligent Spaces**

Spaces will hold properties specific to their function. Building on the previous point the spaces should 'know' who their neighbours are and know what they need In order to perform their function.

Create **Flexible Tools**

The tools created should be a small number of generic tools, with their own specific functions that be manipulated to serve alternative functions i.e. The corridor objects can be contracted to form flexible reactive skins. It will also be necessary to create objects specific to a certain project, but still with a view that they could be easily edited.

The Experiment

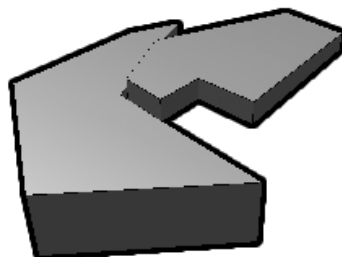
The experiment will be conducted on a proposal for a new National Museum of Modern Art in Athens, the brief and site have already been defined. Therefore it will be necessary to use the methodology and technology developed in the GenDes Masterplan stage to model the site data and create a data model of the brief¹, in a way that will be legible to the digital tools we will create. The digital tools will be in the form of objects, that can be dropped into a standard CAD package² and manipulated by the user, after we have created our object and modelled the brief and site so that it is legible to both the human designer and the objects.

The game is to see whether, a convincingly resolved and complex building project can be generated in a week. The benchmark for the test will be asking if the project is equivalent to a traditionally designed building, paying particular attention to level of resolution and complexity. The resolved building should then be tested to see how 'easy' it is to make changes to the fundamental design decisions. The final presentation will be the raw output from the standard CAD package, it will not have been processed or post produced in any way.

Objects

The objects are divided into two main groups, those that are generic tools that could be used on most projects, and those that are specific to the project brief, in the future the number of objects and their complexity will grow to create a vast library of powerful objects. The Gendes1.0 total project time in future projects will be influenced by the amount of new tools that would need to be built or modified in order to design the building. In the case of the Museum, all objects had to be built from scratch as there were no precedents, however, a new project would be possible in much less time. The Museum project object development time, was restricted due to the requirement that the project needed to be designed in the final week of the experiment. However the following library of objects was constructed in the time allocated. The generic object 'circulation core' is not documented here but is represented in the video **gendes1_experiment.avi**, which can be found on the CD accompanying this report, alternatively you can request a copy from gendes@timmcginley.com.

Generic Objects



Spaces Object

The spaces object is the main object that controls the whole building system. Each space object is actually a group of spaces, chosen from the brief by the user.

¹ See **Appendix01** for the data model.

² Currently ArchiCAD, but could easily be adapted slightly to be used in AutoCAD or SketchUp

Circulation Object



The circulation object controls the circulation between spaces, It is fully parametric and can be set with or without a ceiling. Also the walls can become balconies

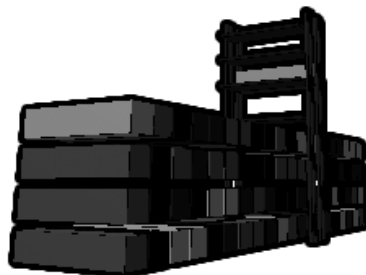
Duct Object



The duct object is a representation of the environmental system of the building, it could also serve as a structural element. The number of segments can be adjusted.

Project Specific Objects

Art Space



For this museum project after analysing the brief and site it became apparent that a specific object should be created to deal with the storage of Art.

Data objects

Site Data

Derived from the site analysis

Grouped Space Object Data (brief)³

Derived from the brief. The brief is processed into groups, from which individual spaces can be aware of their position in a global building hierarchy, the data is presented to the user in a manner that is suggestive rather than explicit.

³ For more information see **Apendix02**

Object groups

The object groups are applied mainly to the space objects. They enable the designer to specify which spatial group (i.e. Admin or a particular gallery space) their object should represent. This means that it is possible for all the other objects to know what type of space they are serving and to act accordingly, this also means that global decisions can be made externally and applied automatically to specific spatial groups.

Data Structure

The key feature to the success of this project can be measured by the sociability of the objects, if the spaces are talking to the core circulation for instance then the project is already half way complete. This is because in order to make use of any intelligence on the machine side of the project, it is necessary to have all the objects expressing what is happening to them, so that an intelligence can suggest ways for the objects to adapt. The machine intelligence side of the project will be investigated next year in GenDes2.0.

The Process

The process of creating the Museum with the tools was similar in lots of ways to other more conventional processes of design. Once the generic and most of the project specific objects had been created, the objects were dropped into the plan in the rough zone and elevation specified by the user/designer. The space objects were then pulled and pushed into position, whilst providing the user with feedback on their position, current relationships and area. Originally it was hoped that the space objects would contain their own wall and ceiling functions etc. however it was found to be more successful if the space objects were used as floor plates with attachable points at their corners that other objects for instance walls could be clipped onto.

This process encouraged the evolution of walls and skins that were not controlled by any specific space but to the composition of the spaces, clipping onto the floor plates as they searched for spaces that need them. This meant that whilst the system had the advantage of using elemental (individual spaces) to manipulate the building, In this particular project the spaces do not directly influence other objects such as the skin element, this is to be developed in GenDes2.0

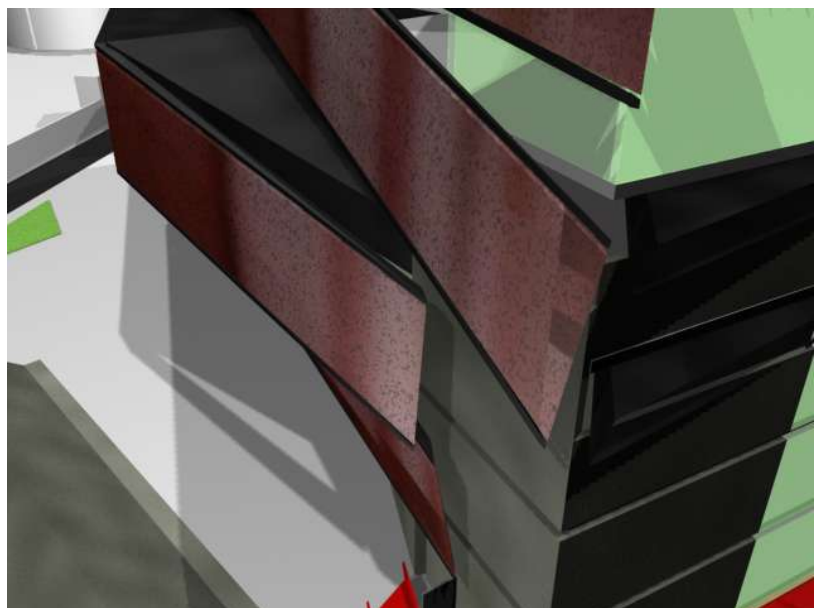
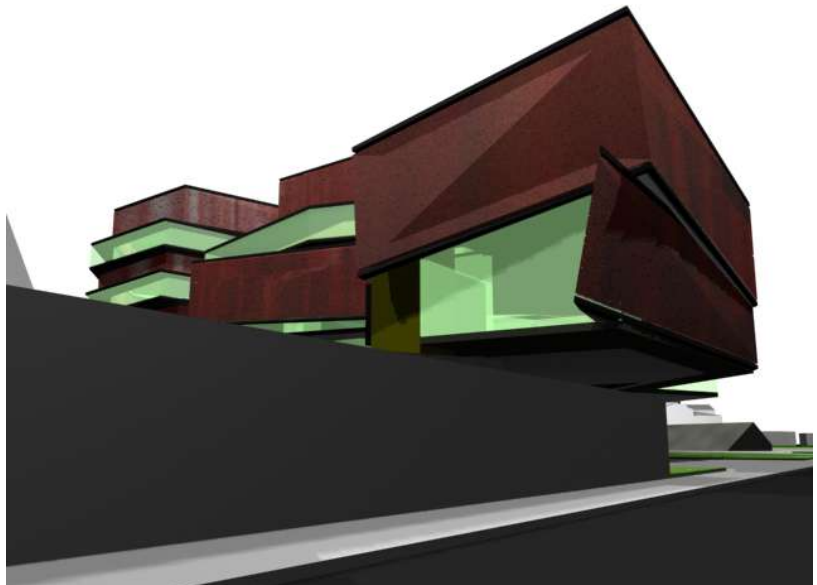
When I first started playing with the circulation object it was great fun to twist and mold it into making the required connections, with no constraints it just looked instantly good. However whilst this was fun, the building was 'made up' as I went along and this lack of structure to any of the decisions started to cause problems later. The answer seemed to be to rationalise the circulation. Instantly my heart sank, this Hadid esque forms suddenly looked perfectly normal.

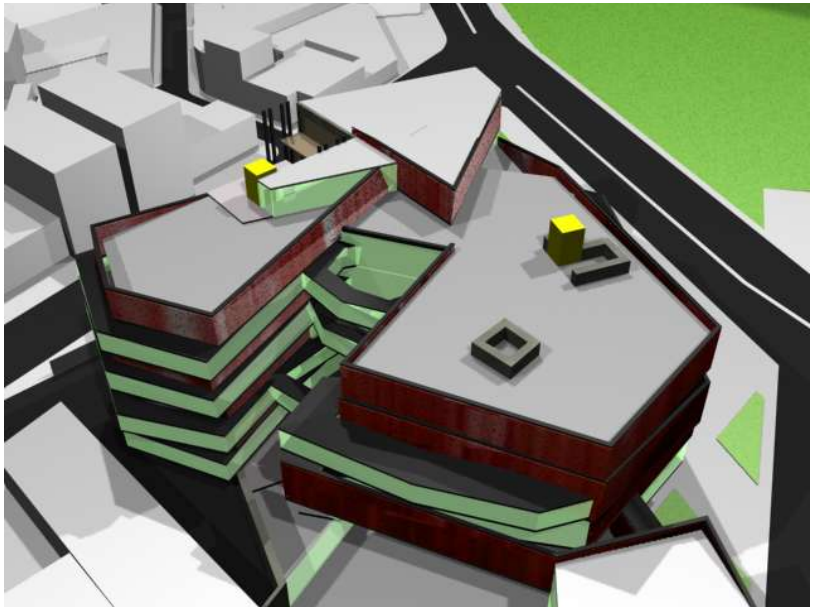
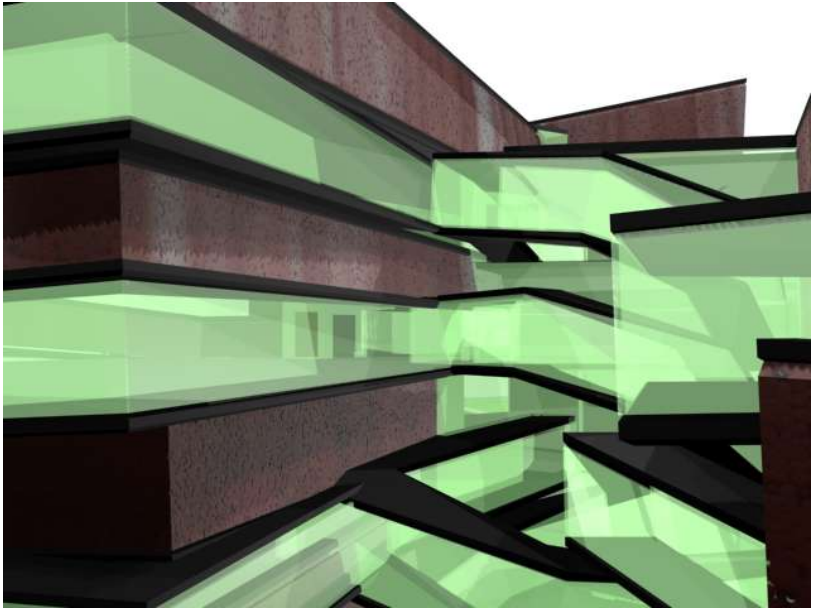
This is when the breakthrough came, on the inside of the circulation, should we have solid standard walls or create a new project specific object to fill the gaps? The answer was obvious, elevate a copy of the circulation paths that wrap around the north westerly galleries and squash them to the width of a wall (easy to do with parametric objects). The result was that the squashed objects did not always behave themselves and started to pummel into other spaces and create

some great new spaces. From these points it was then possible for the squashed objects, to become taller, change material and become the skin of the building. These new 'skin' objects tended to lean to one side depending on which way they wrapped around the building, informing the language of the wrap.

Pretty pictures

I felt that it was important, for the imagery of the product of the experiment to be largely unprocessed. It was hoped that this would the viewer to visualise the produced 'building' as a suggestion of what is possible, rather than a prescribed result. This is why the pinned up presentation looks quite raw. The aim for the next experiment will be to generate the presentation from a parametric layout to be called 'AutoPresent'. However once the experiment had reached its conclusion in the form of the 3 A1 boards and a couple of days had passed, I started to really want to process the building and make it look 'finished', In order to help analyse the result. The next couple of pages show the results of this process.





Purely 'Whimsical Architectural' decisions

It was necessary to add to the brief accommodation for artists in residence studios as it was felt that the museum needed a direct creative drive to keep it alive, and that the resident artists could be commissioned to curate the other exhibitions thereby keeping a freshness to the museum.

Conclusion

The design produced is easy to edit, due to the object oriented approach, one action can control a number of parameters. As time started to slip away towards the end of the project, some traditional CAD techniques were sketched on top and around of the objects to seal the building, the two systems worked well together as the traditional methods could be clipped to the spaces in the same way as the objects could. The objects could potentially link to template drawing files allowing the speedy production of drawings and details. In an office one tech minded employee could support an entire office in the construction of objects that suit the practices particular needs.

Due to the parametric nature of the objects their complexity (number of polygons they use) can be easily modified creating virtual models that are less intensive for the computer to work with, and legible to a greater variety of presentation media i.e. Web based media or games consoles. The system utilises largely untapped data resources within its data structures, and GenDes2.0 could potentially realise a fully automated design process, from contextual data and client requirements through to manufacture. The interface that plugs into the project externally could be very abstract and look nothing like our traditional image of design packages, and yet still produce legible drawings and models through its connections to the standard architectural package. This is a another potential area of research for GenDes2.0.

The system's vast potential for growth comes from the object oriented approach to the design of the object, basically it means that all elements within the object are associated to certain spaces, who are in turn associated to certain served spaces or nodes, which are themselves servant to the site object. The site talks and the objects shuffle about accordingly, without them getting in each others way.

The strong data structures of GenDes1.0 have enabled exciting areas for investigation next year in GenDes2.0 including the integration of artificial intelligence into the objects, providing a stimulating feedback loop for the user. This would manifest itself also in the objects having an increased site responsiveness. The project would also benefit from exploring web based technologies, thereby potentially taking the esoteric software out of the equation and allowing interested people to deal with architectural issues first hand (or second) that previously may have found the subject difficult to penetrate.

Glossary of terms

4PS2+1PC

The project title for the [four PlayStation2 and one PC](#) project that explored the relationship between the human designer and the technology employed in the generative evolution of an unforeseen design from a tangibly large volume of possibilities. But it is only really the relationship between the user and the technology bit that we are interested in here.

AutoPresent

An idea for the final output of GenDes2.0, which will automatically generate a presentation, also brings up the idea of if we were to post produce the building how could we do it in a way that was true to the process that has been explored. How would a machine represent a presentation?

GenDes1.0

Name given to the experiment, although the project is not strictly generative in the sense of an autonomous intelligent machine generating a design it is an investigation of a key stage that would be required in such a process.

Object Oriented Architecture

This means that the spaces and elements in the building are all related and can be modelled hierarchically, this creates logical structures, from which elements can be read and manipulated relationally to each other.

Parametric Objects

Objects that can be manipulated by way of a series of parameters

Programming

The objects have been programmed in GDL a parametric modelling language. The language is an implementation (pretty much is) the BASIC programming language that was very popular in the eighties.

Site Responsive Architecture

This is an evolution from an earlier idea called Site Specific Generative Architecture (SSGA), which was a response to the floating in cyberspace attitude of current generative architecture. The SSGA project delivered imagery that did indeed float in space, but it also outlined the 10 basic rules for a generative architecture process.

Video

If the GenDes1.0 Experiment video did not accompany this report you can request a copy by sending an email to gendes@timmcginley.com

Whimsical Architectural Decisions

The thrust of the research is to move away from this method of design, however it is still a very good way for us to engage with a design problem and establish tangents from which the design can grow. The tools and the work done in future will always be constructed with the idea that the designer can sketch on top of them.

Appendix 01 (sample of the xml building data structure)

This data is the purest form of the site data it is very portable and would be very happy on the web based client application with remote users controlling their own version of the building design or cooperating to create a team or community project.

```
<!-- http://www.timmcginley.com -->
<!-- xml schema brief for museum of modern art -->
<!-- need to work out which data structure best fits this data -->
<!-- up date the dtd file where are the variables most easily placed -->
<!-- are spaces individually defined objects or variables of spaces? -->
<!-- spaces that don't need natural light could be thrown into the pit -->
<?xml version="1.0"?>
<!DOCTYPE building SYSTEM "building.dtd">
<building>
  <entrance_main>
    <spaces>
      <entr_cent>
        <area?></area>
        <served>1</served>
        <name>"central foyer"</name>
        <pub>1</pub>
        <nat_light>1</nat_light>
      </entr_cent>
      <entr_lobs>
        <served>0</served>
        <area?></area>
        <name>"lobbies"</name>
        <pub>1</pub>
        <nat_light>1</nat_light>
      </entr_lobs>
      <entr_secc>
        <served>0</served>
        <area?></area>
        <name>"security checkpoint"</name>
        <pub>1</pub>
        <nat_light>1</nat_light>
      </entr_secc>
      <entr_tick>
        <served>0</served>
        <area?></area>
        <name>"ticket desk"</name>
        <pub>1</pub>
        <nat_light>1</nat_light>
      </entr_tick>
      <entr_clok>
        <served>0</served>
        <area>100</area>
        <name>"supervised cloakroom"</name>
        <pub>0</pub>
        <nat_light>0</nat_light>
      </entr_clok>
      <entr_puwc>
        <served>0</served>
        <area>2x112</area>
        <name>"public lavatories"</name>
        <pub>1</pub>
        <nat_light>0</nat_light>
      </entr_puwc>
    </spaces>
  </entrance_main>
  <shop_and_cafe>
    <spaces>
      <entr_shop>
        <served>0</served>
        <area>100</area>
        <name>"museum shop"</name>
        <pub>1</pub>
        <nat_light>0.5</nat_light>
      </entr_shop>
      <entr_cafe>
        <served>0</served>
        <area>75</area>
        <name>"museum cafe"</name>
        <pub>1</pub>
        <nat_light>1</nat_light>
      </entr_cafe>
    </spaces>
  </shop_and_cafe>

```

Appendix 02 (code from education group data file and variables)

The actual data base used in this project consists of groups of files that the served programme (in this case ArchiCAD) uses to interpret the brief.

```
"educ_lbrd";250;library and reading room;1;1
"educ_lbrn";30;librarian 2no;1;1
"educ_rsbs";75;reserve book stack;0;0
"educ_lec1";100;lecture rooms AV rooms 01;1;0
"educ_lec2";100;lecture rooms AV rooms 02;1;0
"tech_itmn";20;IT AV services manager;0;1
"tech_itec";20;IT AV technicians;0;1
```

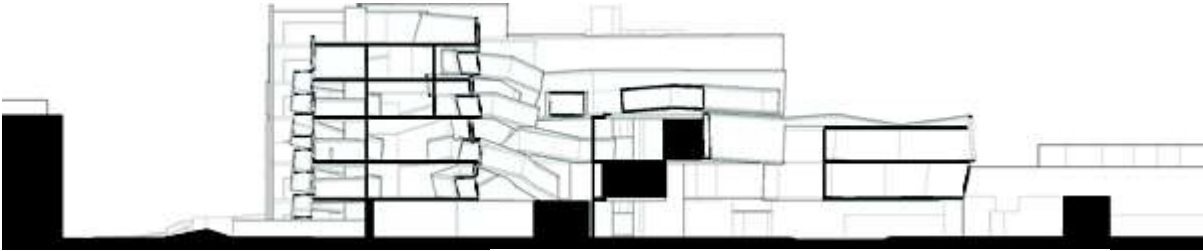
The first element in the code (before the ; separator) defines a name for the computer to refer to the space, the second is the recommended area, the third is the name to show the user. The final numbers are variables for the public private nature of the room (1 = public, 0 = private). The final value represents the requirement for natural light. The number of variables is nearly infinitely extendible, in truth the building could be controlled with a little more than are held here.

Warning geeky bit:

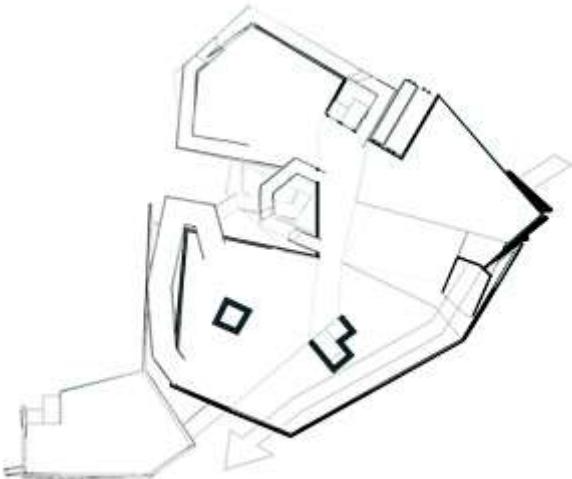
it is possible to store a number of variables in one variable if we represent each of the variables as having positive values 1,2,4,8,16,32,64,128 which equals 255 it is then possible to look for the presence of the other variables within a 255 capacity variable thereby confirming the positivity of the 8 variables it could possibly contain, it works because any number between 0 and 255 (a range of 256) can only be represented by one single configuration of the eight value switches i.e. $9 = 1+8$, $115 = 1+2+16+32+64$.

This is interesting because it means that distinct architectural relationships can be established as variables containing sets of defining variables specific to that host, creating situations were it might be possible perform potentially human brain taxing processes on groups of hierarchical relationships that are intuitive to us.

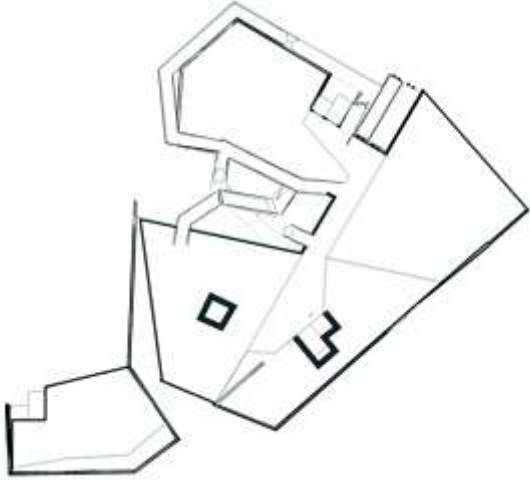
Apendix03 drawings



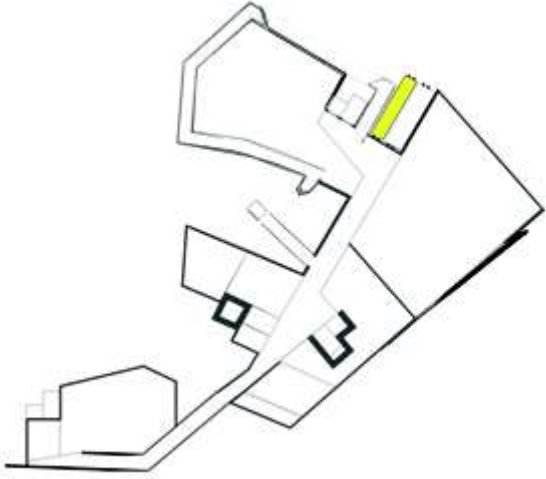
LONGITUDINAL SECTION



THIRD FLOOR



SECOND FLOOR



FIRST FLOOR