

Novigrad – Procedural Art

Research Document

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1. City Layout



The main thing you notice while looking at a top-down view of the city is that there are no apparent grid structures, with roads rarely ending with a dead end. It seems like the streets are all connected together to form a fluid and organic network and the buildings are placed based on that road.

Besides the inner structure of the city, another thing to be observed is the fact that Novigrad is mostly surrounded by water – making it almost an island city with bridges and ports connecting it to the surroundings.



Verticality is perhaps the most important aspect of Novigrad's design. It structures both physical geography and human demographics. It seems like the higher you go in Novigrad's districts, the wealthier the people living there – and as such – the richer the buildings. The lowest districts in the city house the poor people and the working class.



Improvised buildings from clay, straw, wood planks in the lower areas



Rich brick buildings with proper roofs in the upper districts



The city center is also filled with open markets, fountains



And finally, the city is surrounded by walls all around its perimeter, making it look almost like a castle.

2. Architectural elements

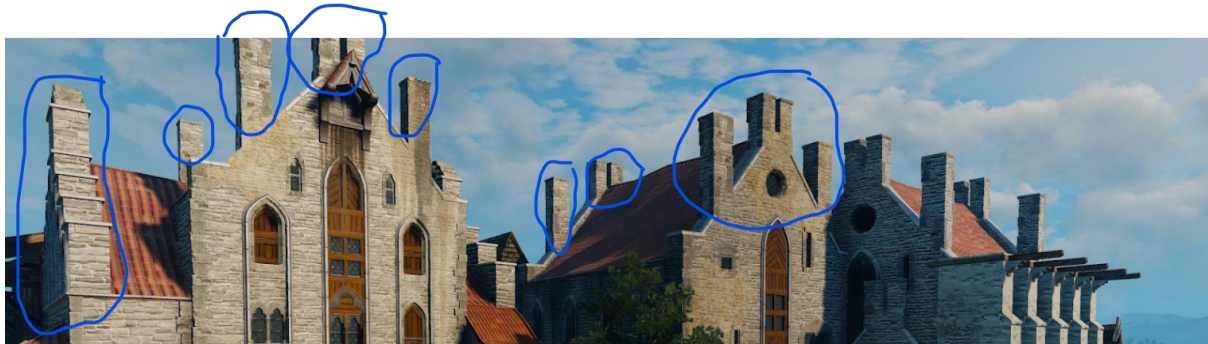
On a low level, almost all buildings in Novigrad are rectangle-shaped, with some being L-shaped. The buildings most differ from each other in their “facades”. A few different building types can be seen throughout the city, ranging from tall white and red brick buildings with very rich and minimalistic looking facades with stone elements, to small clay buildings with wood crossings, patches and generally worn down looks in the lower and poorer districts. The walls of brick buildings are clean, and look like they are almost one piece, while the poorer buildings’ walls are segmented with vertical and horizontal supports holding it up.



Segmented façades of poor buildings



Clean façades of rich buildings



Another aspect that makes poor and rich buildings different is the roof. Poor buildings have mostly normal looking roofs – besides the cheap/improvised materials – while richer buildings can all be seen with these stone pillars on top of them.



Another building type that can be seen throughout the city, even though it is less common, is a red brick building similar in almost all aspects with the richest, white brick buildings. The main difference is the red buildings are shorter in height.

3. Building style(s)

In this section I will talk more about the materials that make each structure inside Novigrad. Starting with poor buildings the walls use some kind of clay/plaster material with wooden features/pillars. The roofs are made of a straw material or worn-down roof tiles/shingles. Rich buildings are made of white or red bricks, red and rich roof tiles, windows and wood for a few other façade features. The walls and towers surrounding the city seem to be made from similar materials to the rich buildings: white brick and red roofs.

4. Procedural Techniques and Tools

Procedural Techniques

Some of the new procedural techniques I explored for this project and ultimately decided to use were procedural mesh generation and automatic UV creation. For the mesh generation I followed an object-oriented way of inheritance where each “structure” would derive from a mesh generator abstract class. This allowed me to implement multiple structures which are highly parameterized and, thus, highly reusable in many different aspects of the city generation process. Some of the structures I implemented, and their parameters include:

- **Plane**, with parameters such as the plane (XY, XZ, YZ), first axis size, and second axis size. I use this structure mostly for walls, windows and in other places where only one face can be seen
- **Wall**, which is like Plane, but it includes a parameter for thickness and is used where both faces of the wall can be seen.
- **Arch**, with parameters for dimensions and number of points (which allow for a dynamic level of detail)
- **Roof**, which comes in two variants: straight and corner. These are the building blocks for roofs in my city.

and others

All of these structures or generators use the specified parameters and output a list of vertices, triangles and UVs with support for sub-meshes and a lot of settings that control how UVs are generated. The UV generation algorithm is world space aware and makes tiling of materials on procedural meshes possible. It also allows for different modifiers per quad or per triangle which influence how the UVs are generated: flipping on both axes, rotation, ignoring world space position, having the top vertex of a triangle in the middle or on the edge and more.

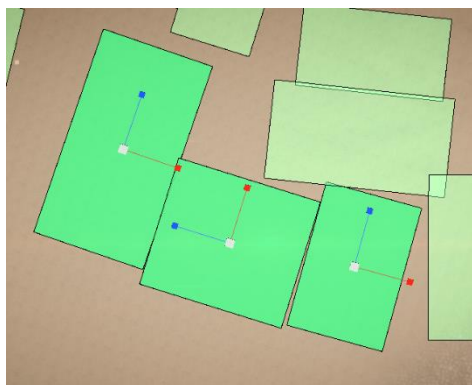
While implementing this algorithm I also experimented with a smarter algorithm which would detect inconsistencies that could lead to weird UVs and fixing them, reordering vertices, but I ultimately failed getting a working prototype.

Editor Tools

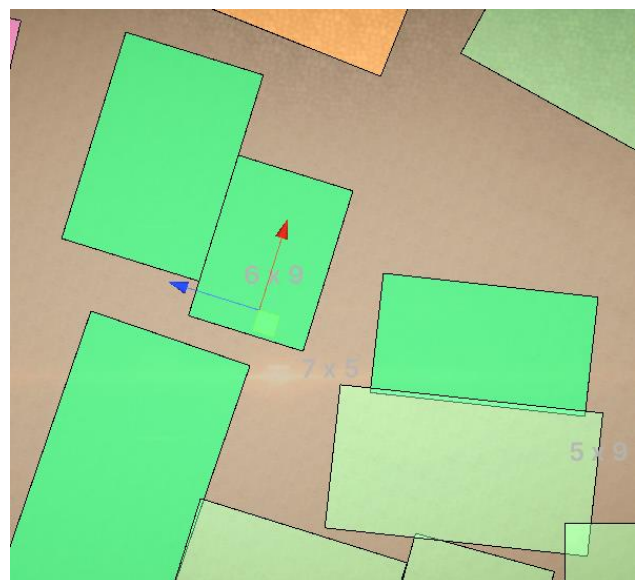
Right from the beginning of this project I recognized the need of an editor tool that allows the placement of buildings because procedural placement in a city like Novigrad can easily lead to undesirable results as the layout is very organic and not grid-like. As such, I began developing a tool that allows me to place and rotate buildings using multiple layers for different types of structures.



The tool supports creating colour-coded layers, placing rectangles, rotating them, changing their size and position. It also supports multi-object editing for fast transformations of multiple “plots”. The tool saves all the layers, rectangles and their rotations to a scriptable object which is later used in my procedural generation algorithm, where every layer corresponds to a different structure type.



Scaling of buildings



Movement of multiple plots by their centre combined



Rotation of buildings