

Roofing

The design of the roofs in Oude Molen took quite a bit of thought and consideration. There are currently nine new buildings in our model that will need roofing, as well as four buildings with which the roof is being changed. These four roofs will change because they currently have a heavy appearance and add a lot of height to the buildings. It is also planned to raise these four buildings one story, so the roofing will have to be removed either way. There were two main aspects we looked at, the materials the roof should be made of and the design of the roof itself.

Materials

There are several different materials that were considered for the roofs. They were narrowed down based on several priorities. First and foremost was cost. Although there is no specific budget set up for the developments in Oude Molen, the material must not be unrealistically expensive. Furthermore, the lower cost developments can be made with, the higher possibility they have of becoming reality. Other aspects of the materials that were looked at were durability, the amount of light they would let in, and the lightness of the material itself. There are two parts of the roof that require different materials. There is the superstructure, or the support, and then the roof itself.

Superstructure

There were four materials initially considered for the superstructure of the roof: aluminum, wood, titanium, and steel. The main aspects looked at within these materials were strength, cost, and durability.

Aluminum

Although aluminum is expensive, it is lightweight and easy to machine. It is fairly corrosion resistant as well, making it a definite consideration amongst the materials that might be used.

Wood

Wood is a heavier option, and may be subject to weathering if not treated. However it is a cheaper option, and is strong as well as flexible.

Titanium

Titanium is very lightweight as well as strong and resistant to corrosion, however due to its high cost and difficulty to machine, was ruled out.

Steel

While steel is cheap as well as a strong material, it was also ruled out because it is heavy, somewhat difficult to machine, and subject to corrosion.

Covering

For the roof cover, glass, ETFE, SPS glass, canvas, PVGU, and tin were considered. The aspects of these materials that were looked at were cost, weight, and the amount of light they would allow for. The four buildings that currently exist that will be raised a level and get new roofing are those labeled A,

B, D, and E in Figure 1 below. Buildings D and E represent how each of the buildings currently appear with an open middle area with slight extensions on the ends (represented by lines). One goal for this area is that if it is to be covered, the feel should be that you don't quite feel completely inside but are protected from the elements (namely rain).

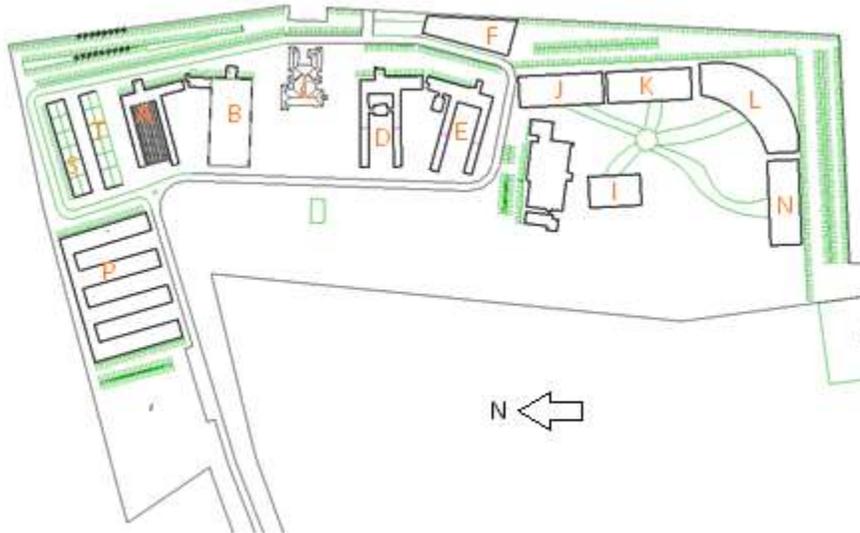


Figure 1: Oude Molen Development Plan

Glass

Glass is a good option because its transparency allows for a lot of light through. Although it is heavy it is also versatile.

ETFE

ETFE, or ethalene tetraflora ethalene is a type of plastic that, like glass, is transparent. It is a good option because it is very lightweight, very versatile, and has a large tensile strength. In terms of installation, it can cost 24-75% less than glass. It is able to bear 400 times its own weight, is recyclable, self-cleaning, and can stretch three times its length without losing elasticity. It can, however, be prone to punctures by sharp edges.

SPS Glass

SPS Glass is a type of glass that, when a current is run through it, will turn from opaque to clear. Although this allows for a unique change of light intensity that can go through it, other materials would provide a better option and it was ruled out.

Canvas

Canvas is an option that was seen used in several places when visiting different places looking at design aspects of other locations. It is lighter in weight and can take many different forms. Although not transparent, it is translucent and allows for more light to pass through than some solid materials, however like ETFE it is also subject to tears from sharp edges.

PVGU

PVGUs, or photo voltaic glass units, are an option to consider because of their solar properties. As solar bricks, they have a power density of 140 watts/m², considerably high compared to 66 watts/m² of standard solar panels, which also require additional material to hold them on the superstructure. They have a high transparency and adaptable design, but a low thermal gain.

Tin

Tin would be a cheap and lightweight option however was ruled out due to its ease of being subject to corrosion.

Design

Many different designs were considered for the roof tops in Oude Molen. Pictures of different roofing styles were analyzed from those taken while traveling with our sponsor as well as research done online. The goal was to create something unique and interesting that still allowed for a lot of natural light to filter through. Design ideas were sketched and then several were modeled in Autodesk Revit.

Arches and Green Roofs

The initial plan was to put a simple arch roof over each structure. Buildings A, B, D, and E from Figure 1 were modeled first, as they currently have the most definite structure. Figures 2 and 3 below show two models that were considered with arches. Figure 2 has an archway simply over the area that would otherwise be open air. Over the building structure itself, a flat green roof was considered. A green roof would be roofing that has vegetation growing on top. This would help prevent large amounts of excess rain water runoff from the buildings as well has hold the potential for gardening areas. Figure 3 shows a simple arch that covers the entire structure.

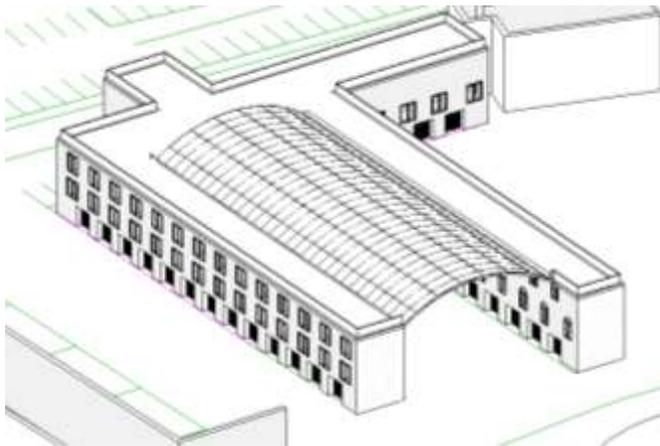


Figure 2

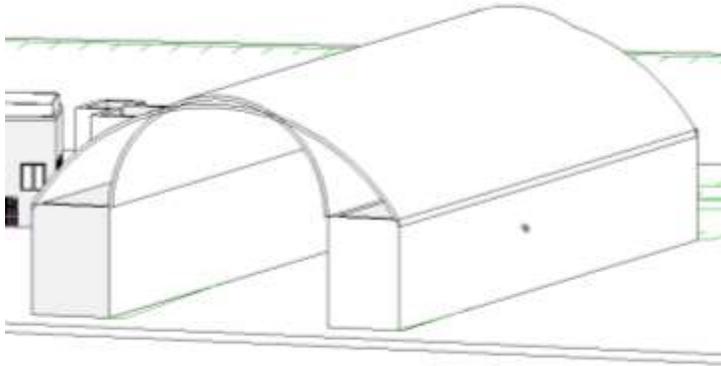


Figure 3

These designs were decided against, due to their unattractively dull appearance. Green roofs in general were also decided against, to prevent any heavy roofing from being implemented in the buildings (would need concrete layer).

Current Design

The current design that is being worked with can be seen in Figure 4. This roof would cover the entire structure, and would not be as simple in design. This wave layout would allow for solar panels to be positioned in such a way that they would be facing the sun, allowing for maximum radiation to be absorbed and energy to be produced.