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Master in Advanced Architecture 2014-15

Designing Associativity
Tutor : Luis E.Fraguada
3rd Assignment
9 March 2015

By :
Orion Campos
Stephanie Farah Carbonell
Mahdi Najafi

Copan residential building, Sao Paulo, Brazil

The main goal of this assignment was to have some experiments with evolutive algorithms in design process, producing a series of generations of best results with this problem-solving method.
The chosen case study for this experiment was the Copan residential building, designed by Oscar Niemeyer in Sao Paulo, Brazil.

Since the building is made basically on a curved organized typical floor and since the main facade of the building is covered by shading louvres (brise soleil), which protect the interior spaces from the west sunlight, we decided to develop a new series of shading louvres with the same size as the original ones, but varying the angle of them along the facade through Galapagos evolutive algorithm.

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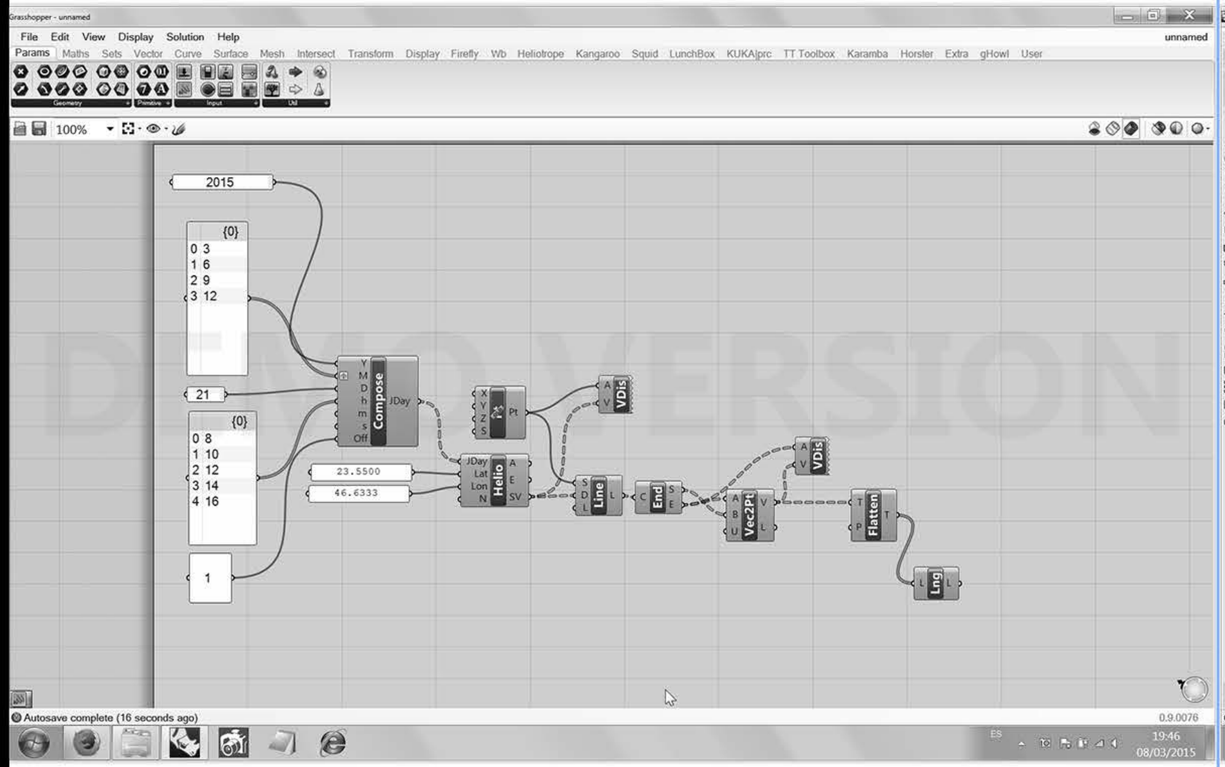

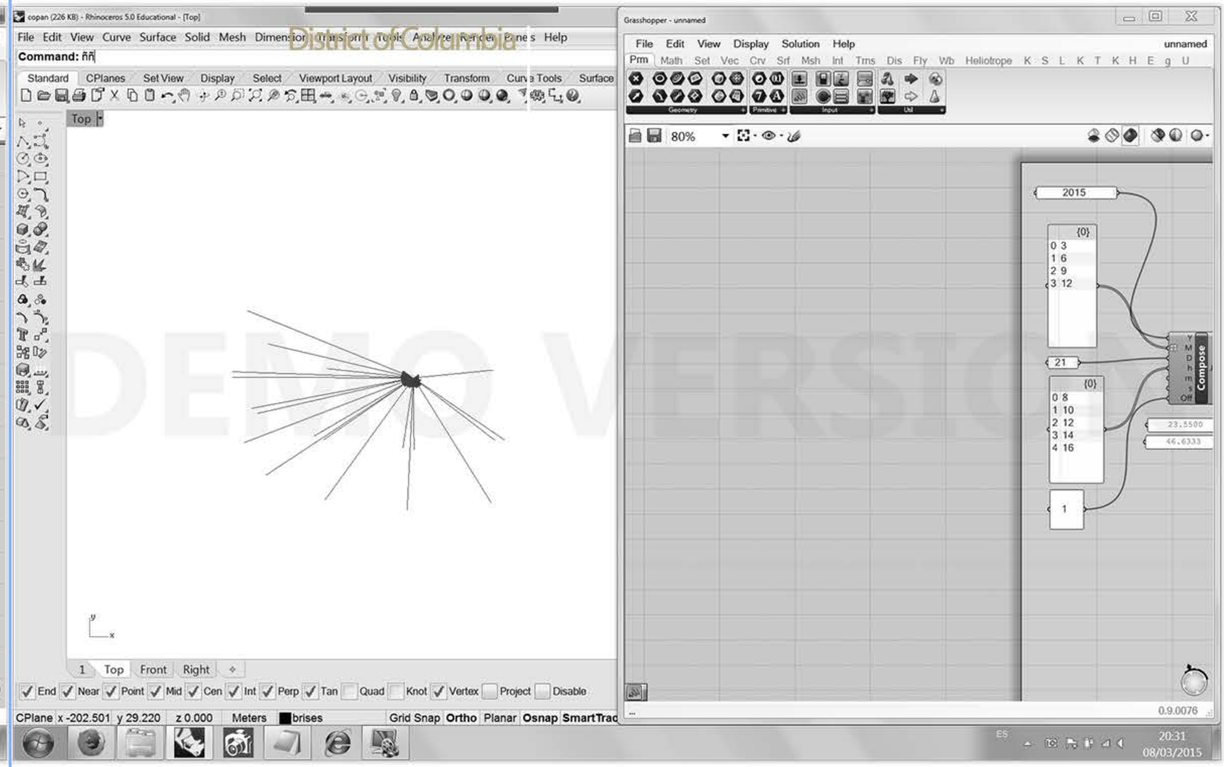

It started by selecting the year and location of the analysis of Heliotrope. The months were Mar, Jun, Sep & Dec, the months of Solstice and Equinox. The day was 21st since usually those days are around 21st. The hours were at 8,10,12,14 & 16 when the sunlight is more intense. The Latitude and Longitude were selected and it created a vector from the points of position of the sun, to the center of Rhino 3D space. Later, this list was flattened and the size of it was obtained.

The vectors of the sun.

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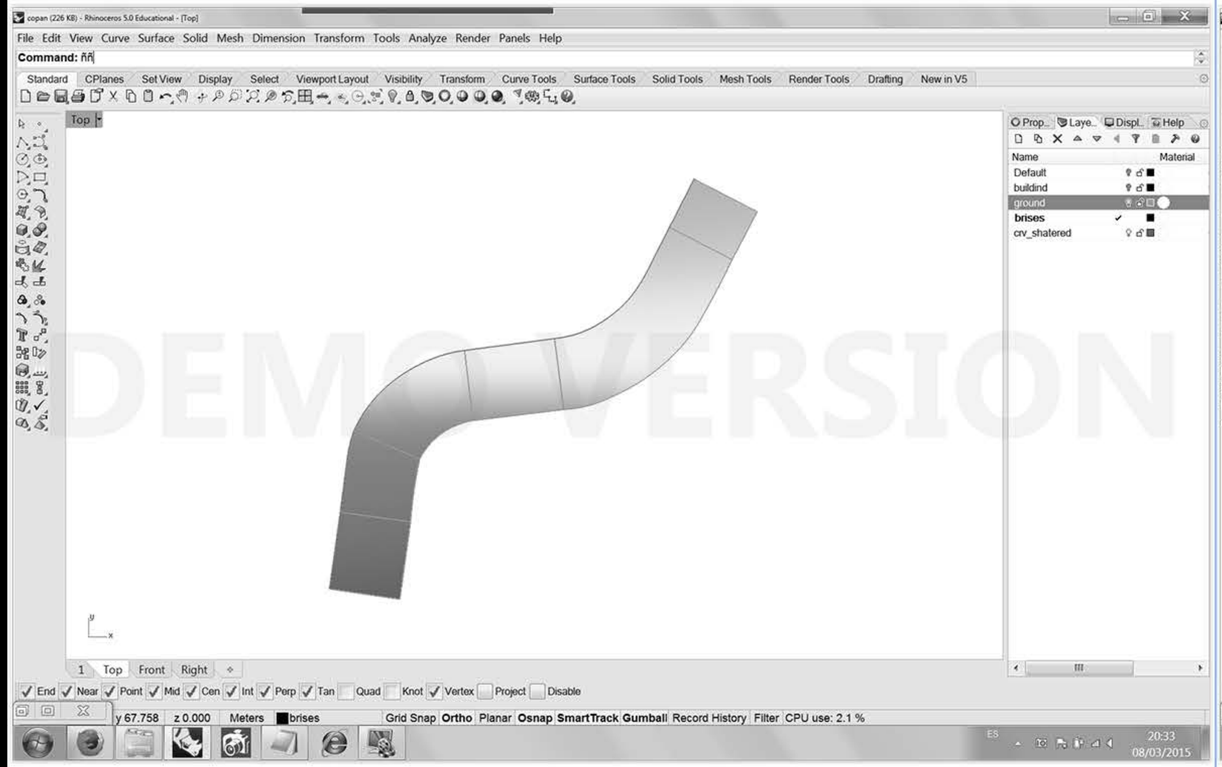
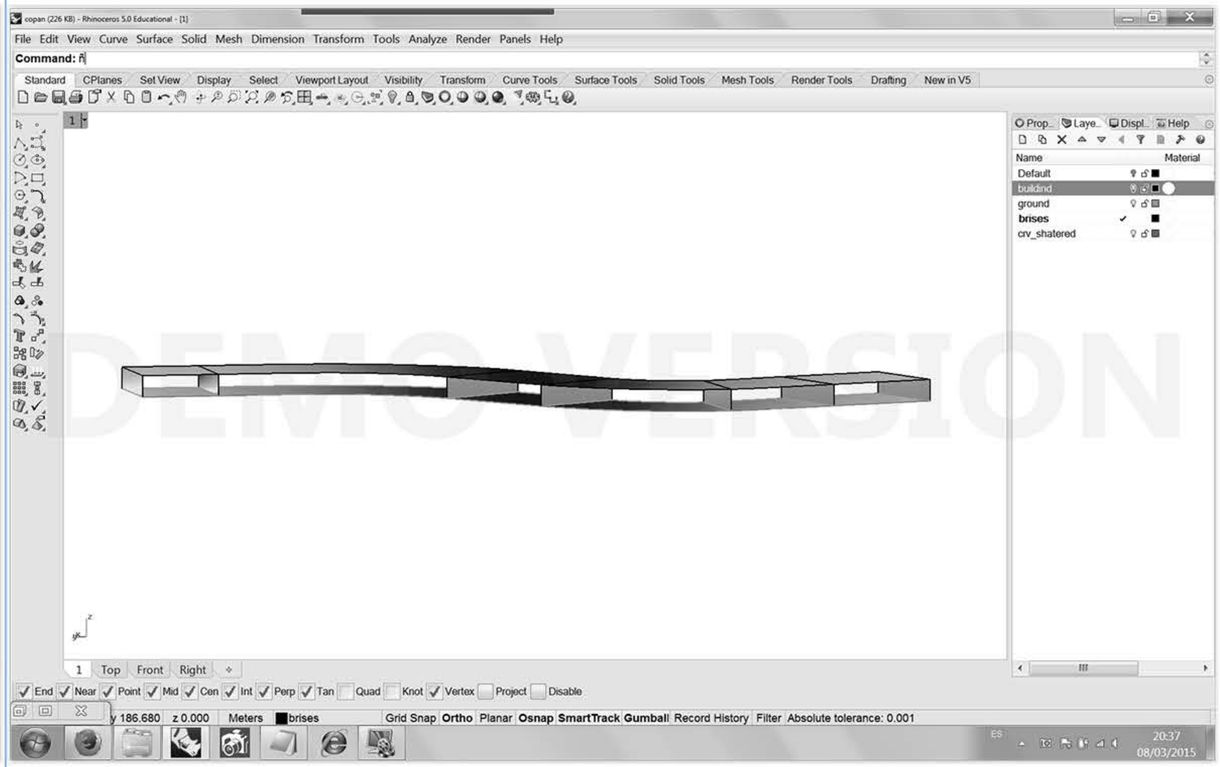


The typical floor of the building was made, and the north was aligned with the Y axis of the model.



And also, the ceiling and walls of each block.

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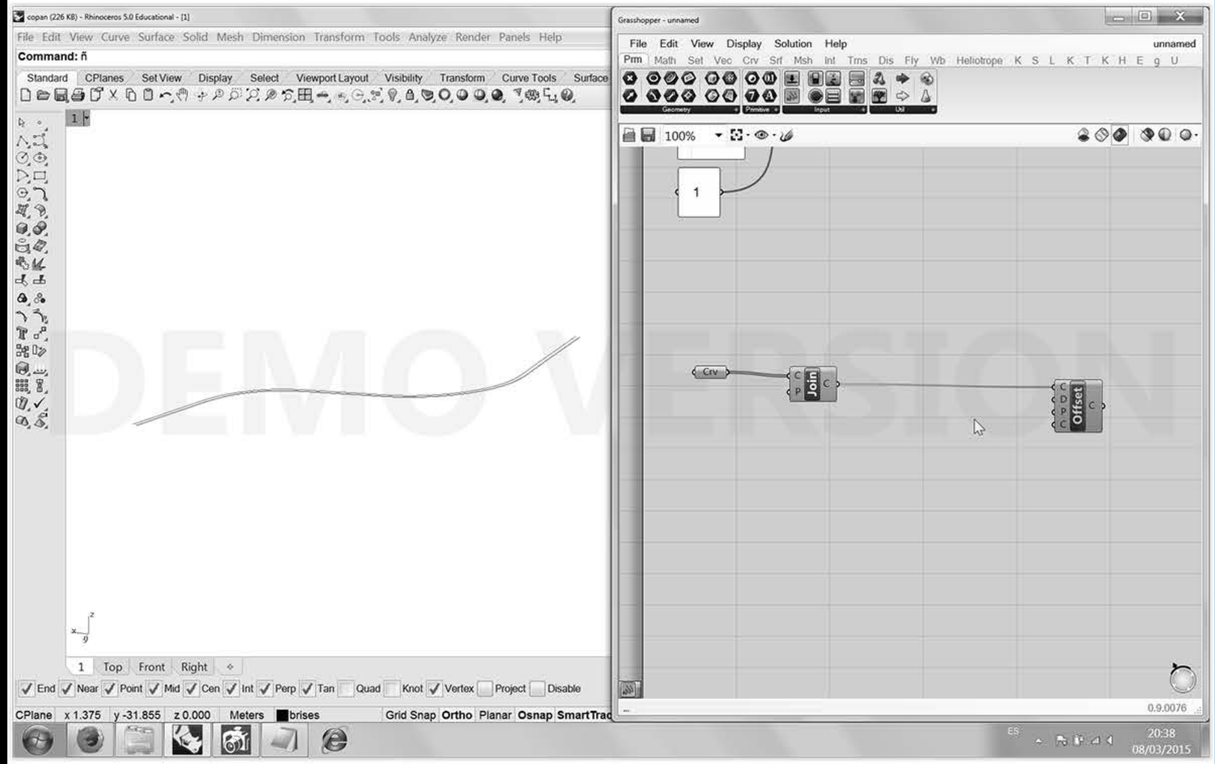
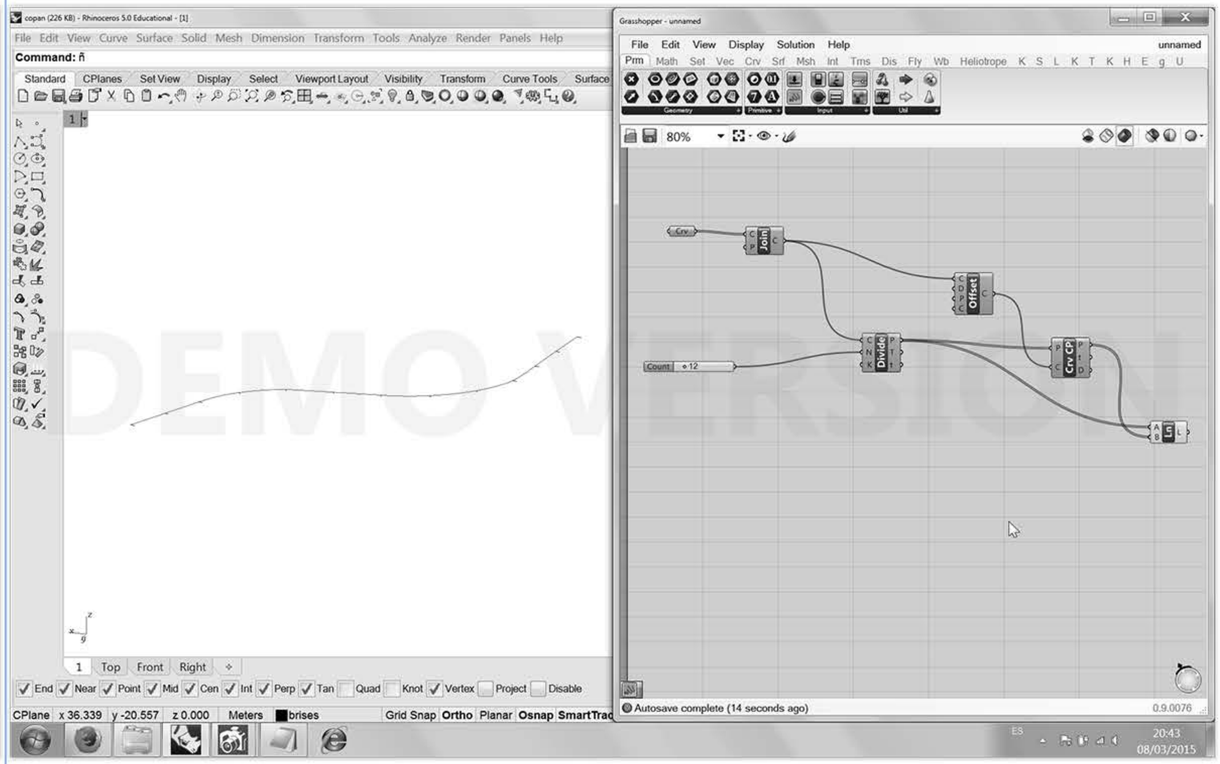


The edge of each block was obtained, joined and made an offset of one meter.



The edge curve was divided and through Curve Closest Point component, 12 perpendicular lines between the curves were made. Although dividing the second curve would be fastest, for some reason, it wasn't working.

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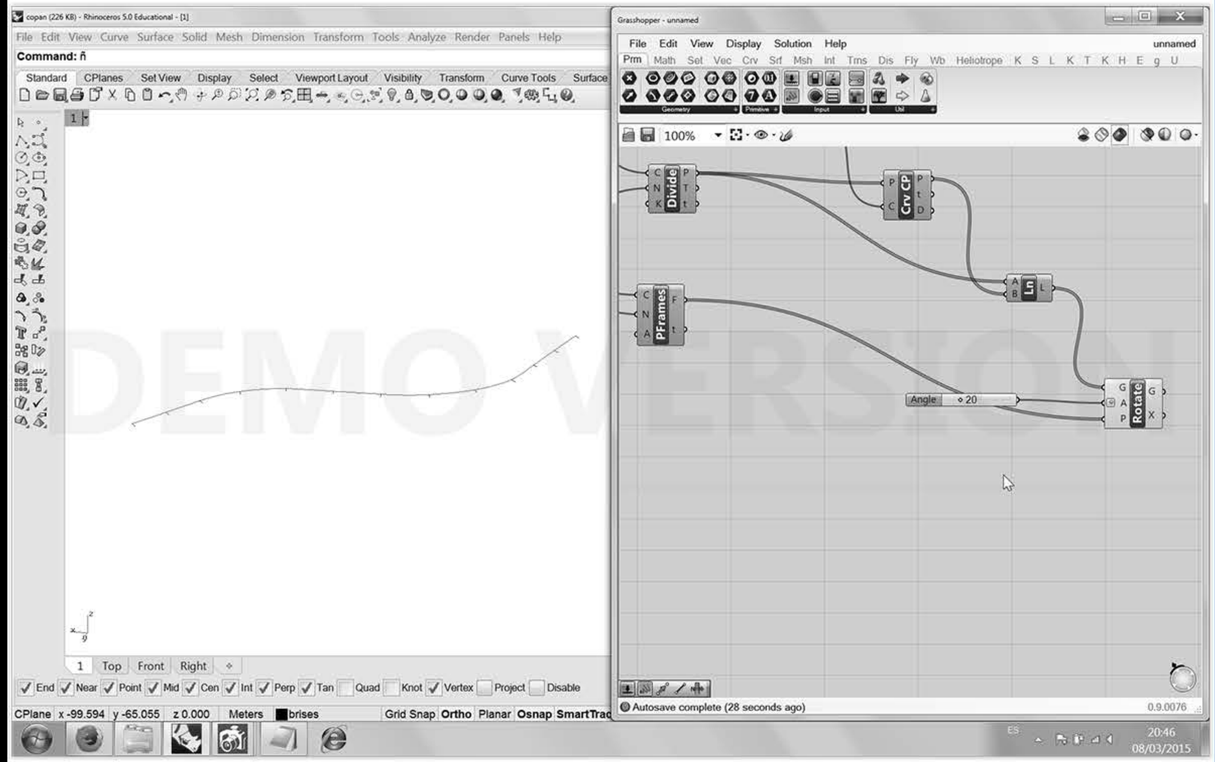
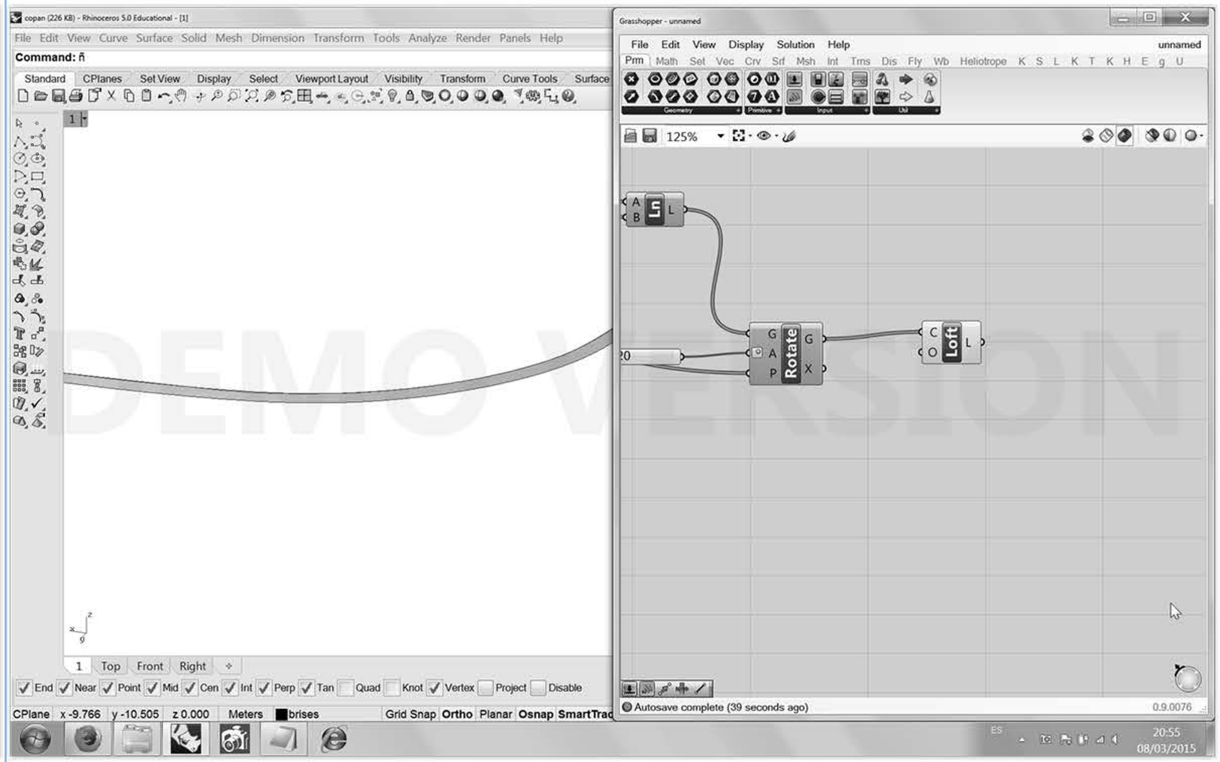


Dividing the joined curve with PFrames component with the same number, created the planes perpendicular to the curve. Later, the lines where rotated in those planes with a slider from 0 to 45, representing the degree of rotation.



Later the curves were lofted.

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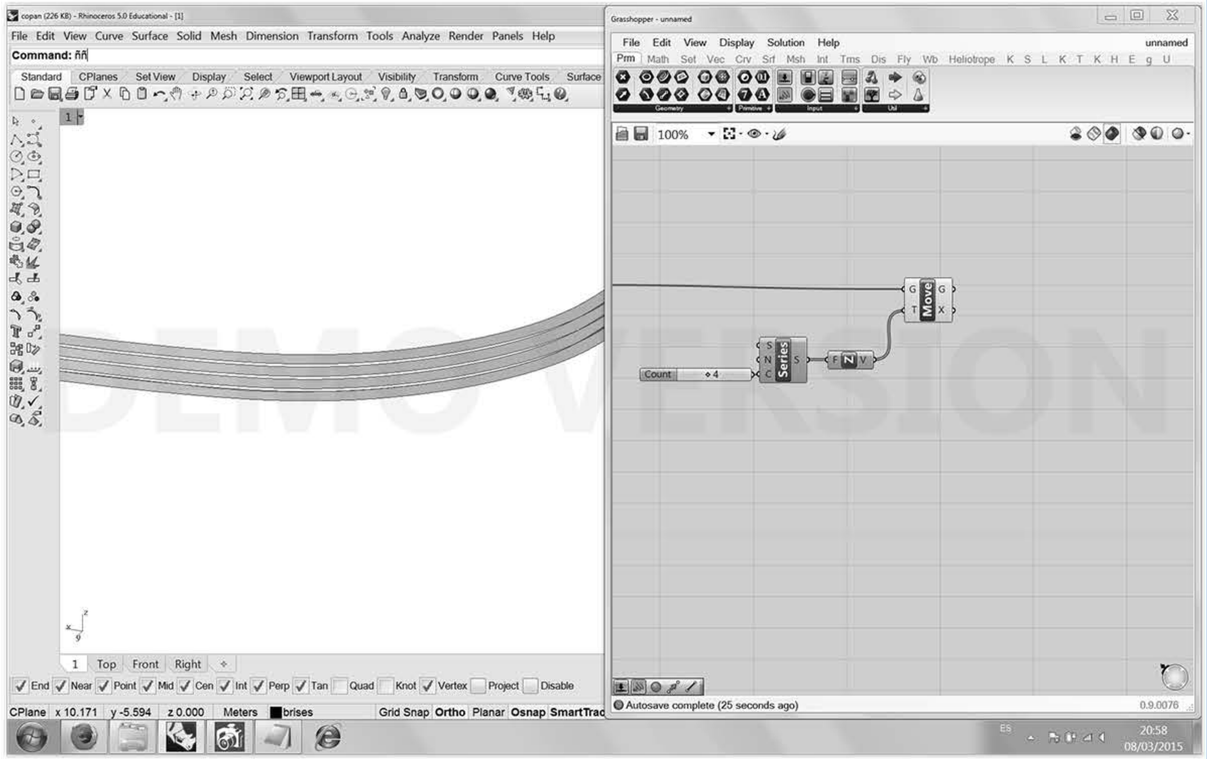
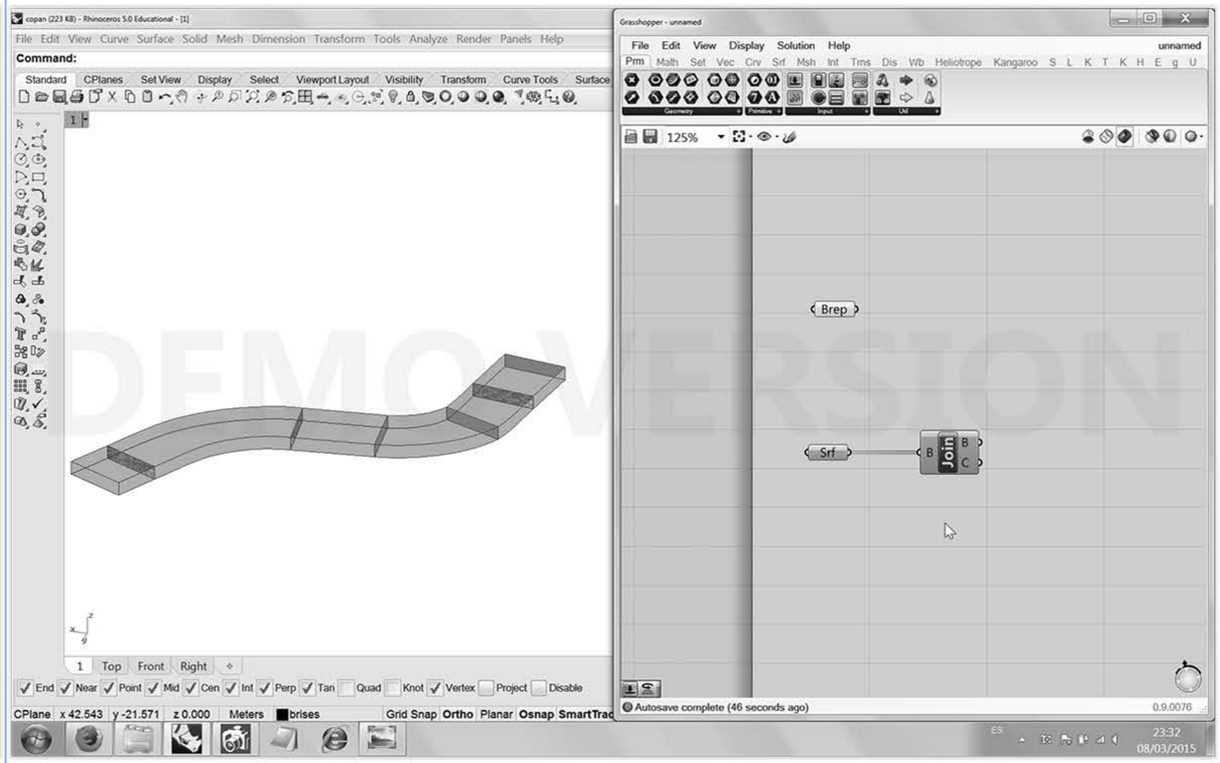


And the lofted surfaces were moved in Z axis 4 times, with an interval of 1 meter, starting with 0.



The ceiling and walls of blocks have been inserted, together with the base floor, which was joined in a brep.

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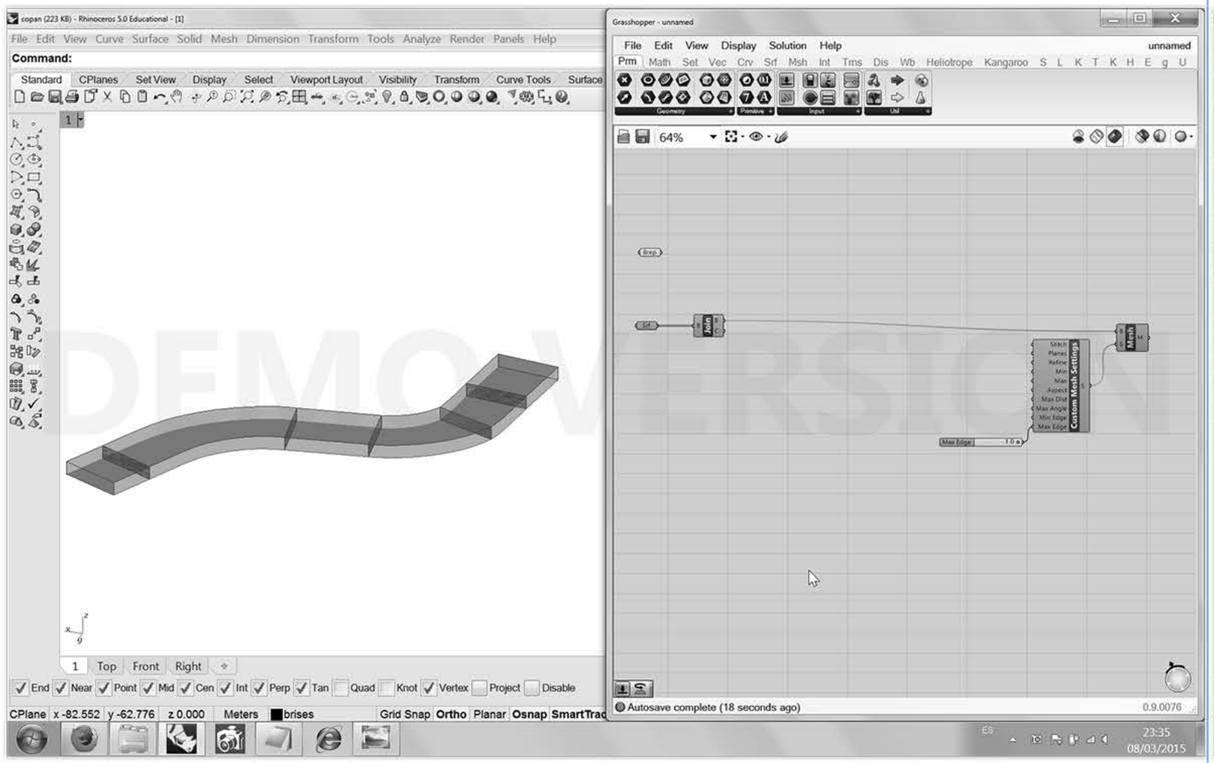
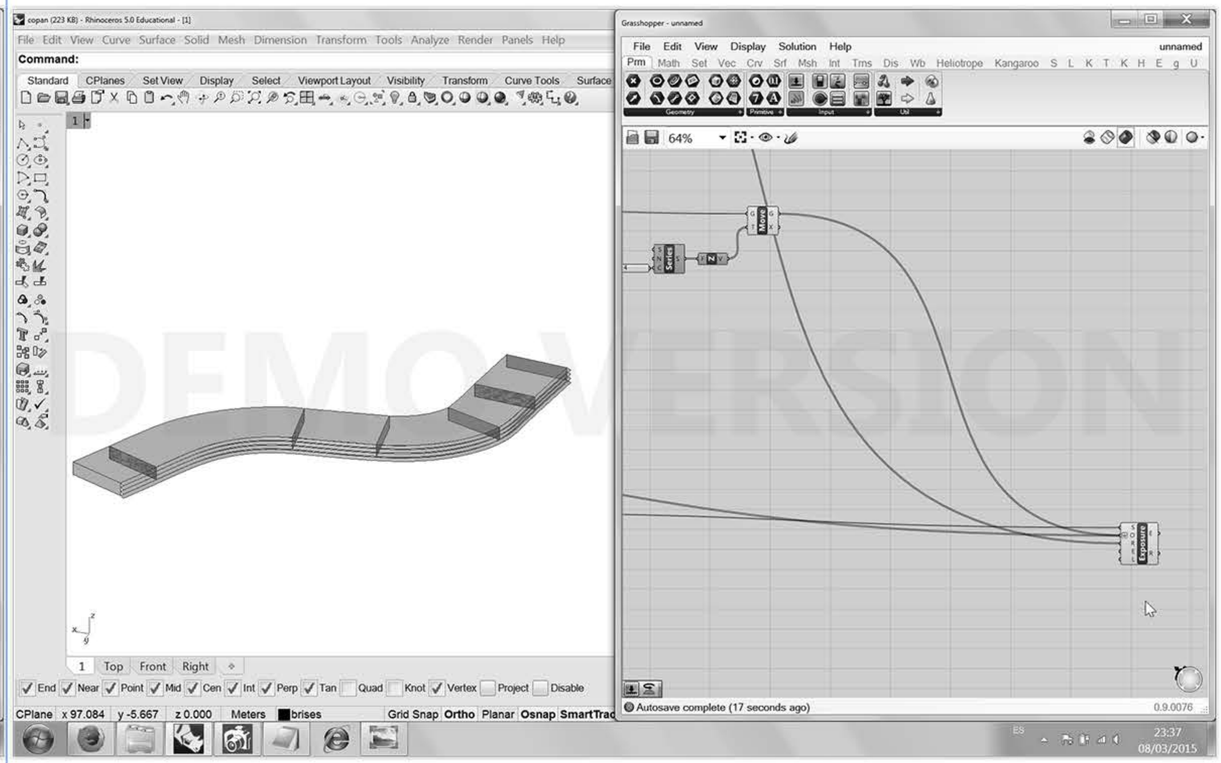


The floor was transformed in mesh, with a maximum edge of 1m, so the mesh would conclude so much details.



To see how much of solar radiation the base floor would receive, the Exposure component was being used. The floor, which was a mesh already, was connected together with the shading louvres, the ceiling and walls of the block, all of them flattened, together with all the vectors of the sun from the hours we set.

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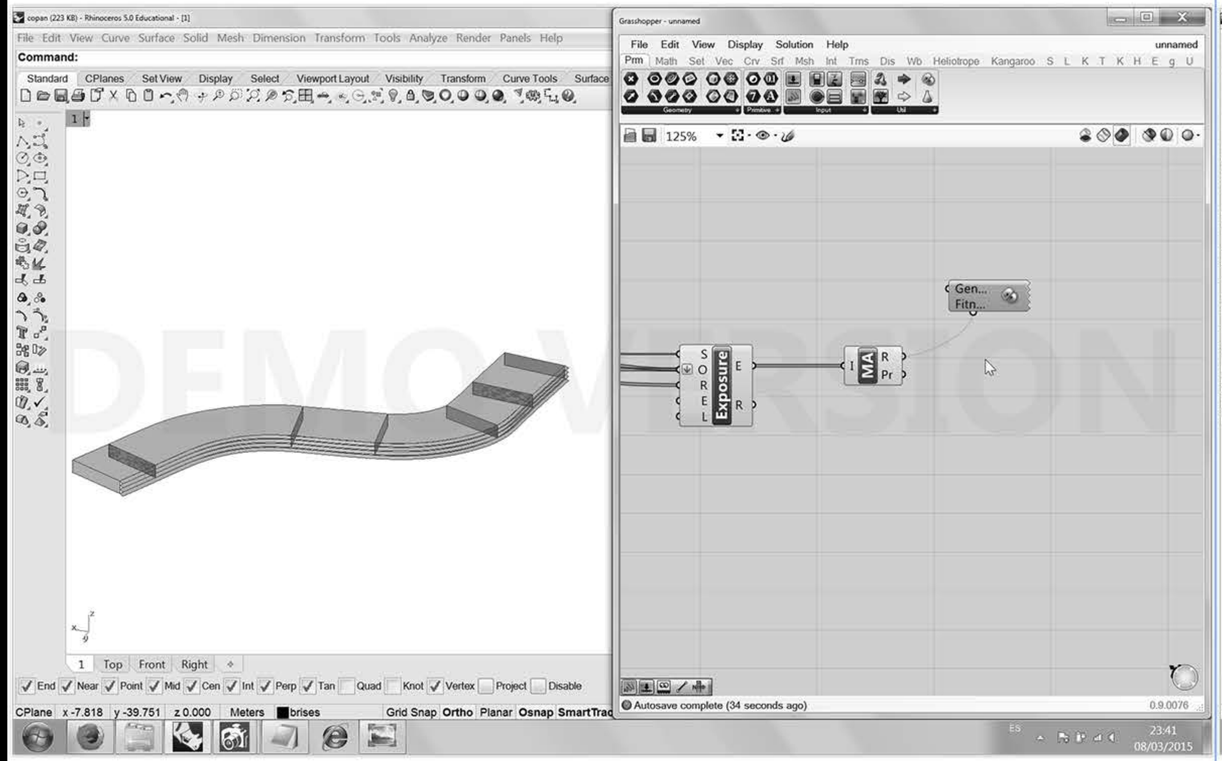
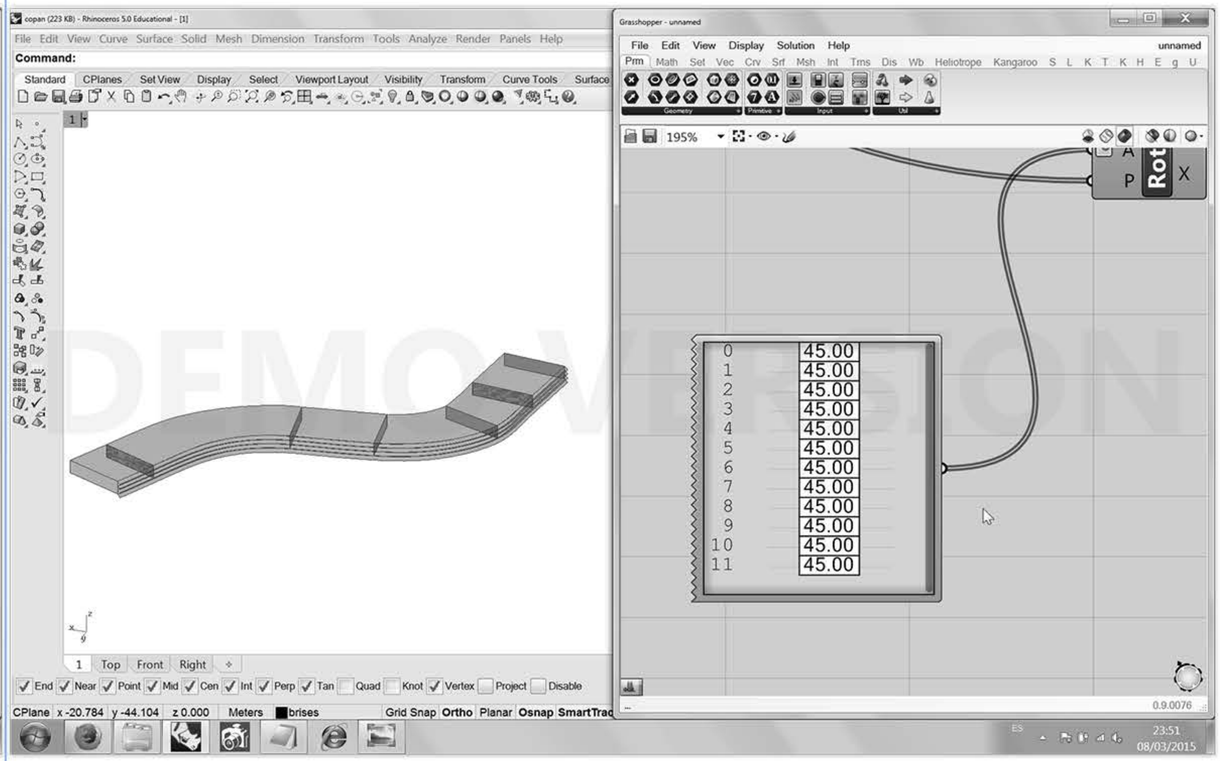


Since the exposure gives a list of values and galapagos works with one input, we used mass addition, and connected to the Fitness side.



The single slider was substituted by a gene pool of 12 elements, since the curve was divided 12 times. The values goes from 0 to 90, corresponding to the degree. Later, it was connected to the Genetic input of Galapagos.

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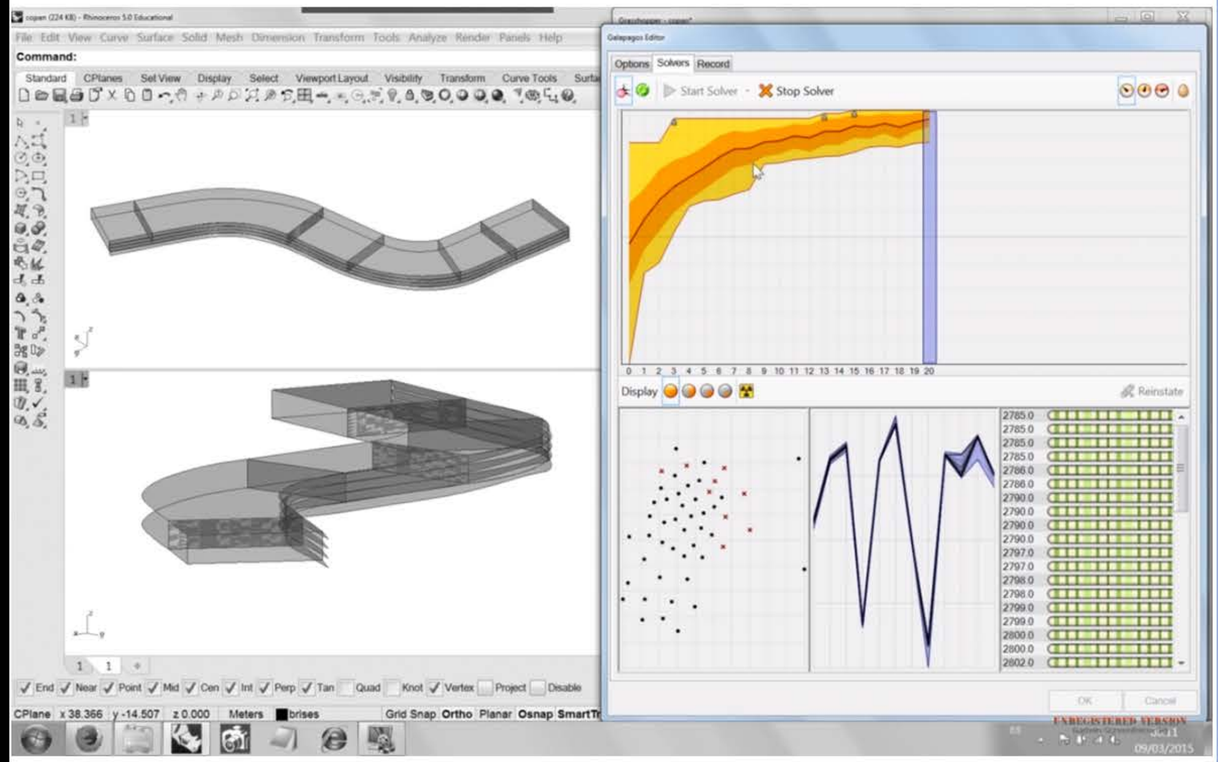
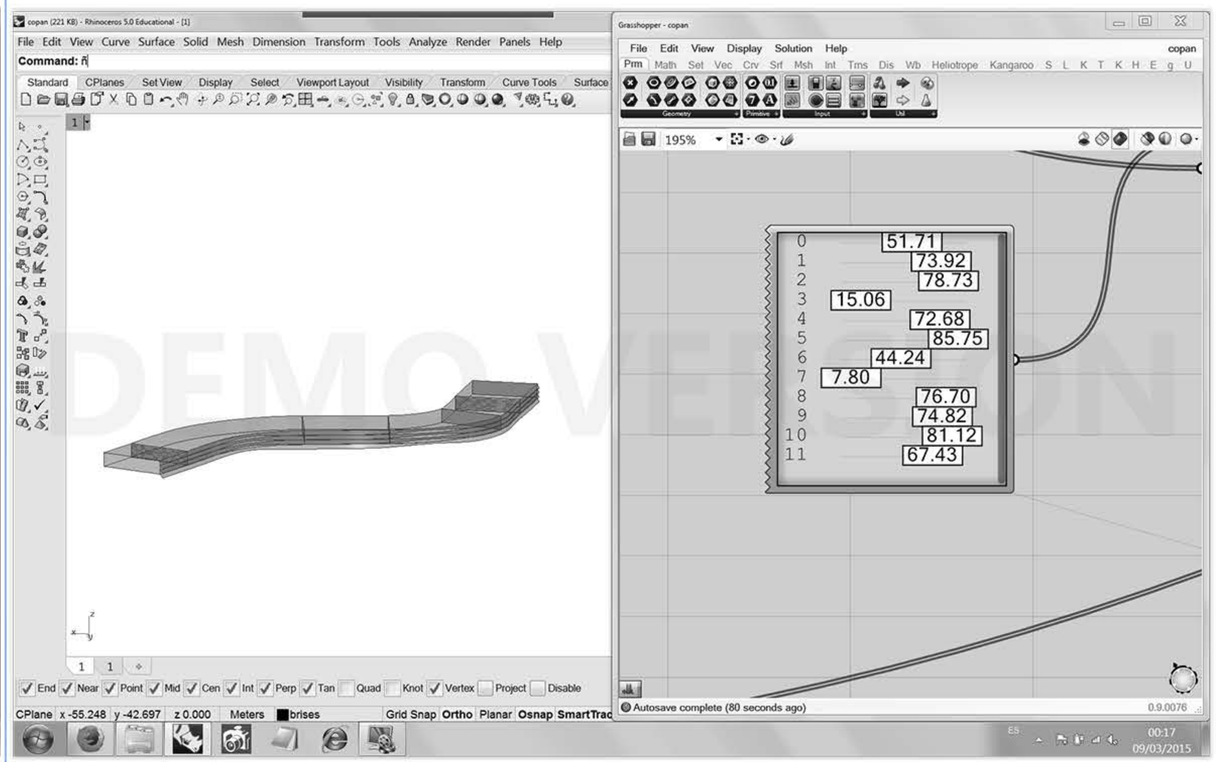


Now, Galapagos started the evolutionary computation.
>The recorded video of this process is available on vimeo.com:
https://vimeo.com/121696646



After runing the analysis, this was the best configuration after the fittest of 21 generations.

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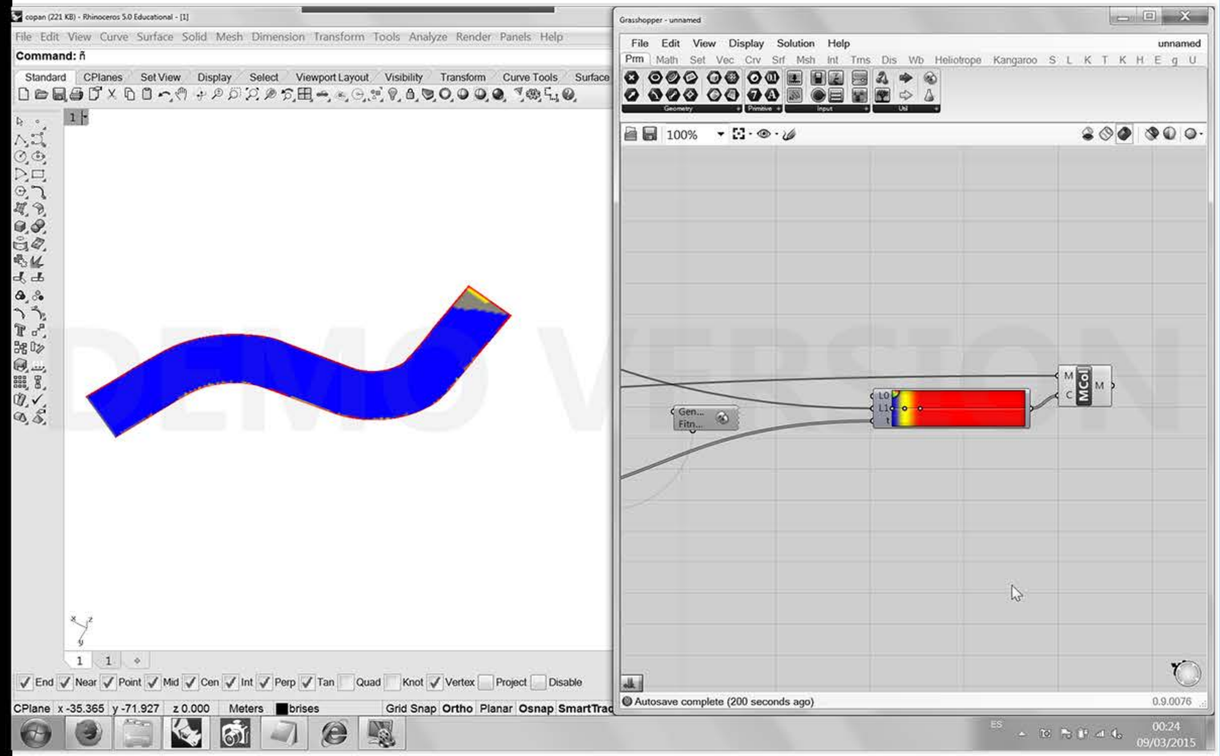
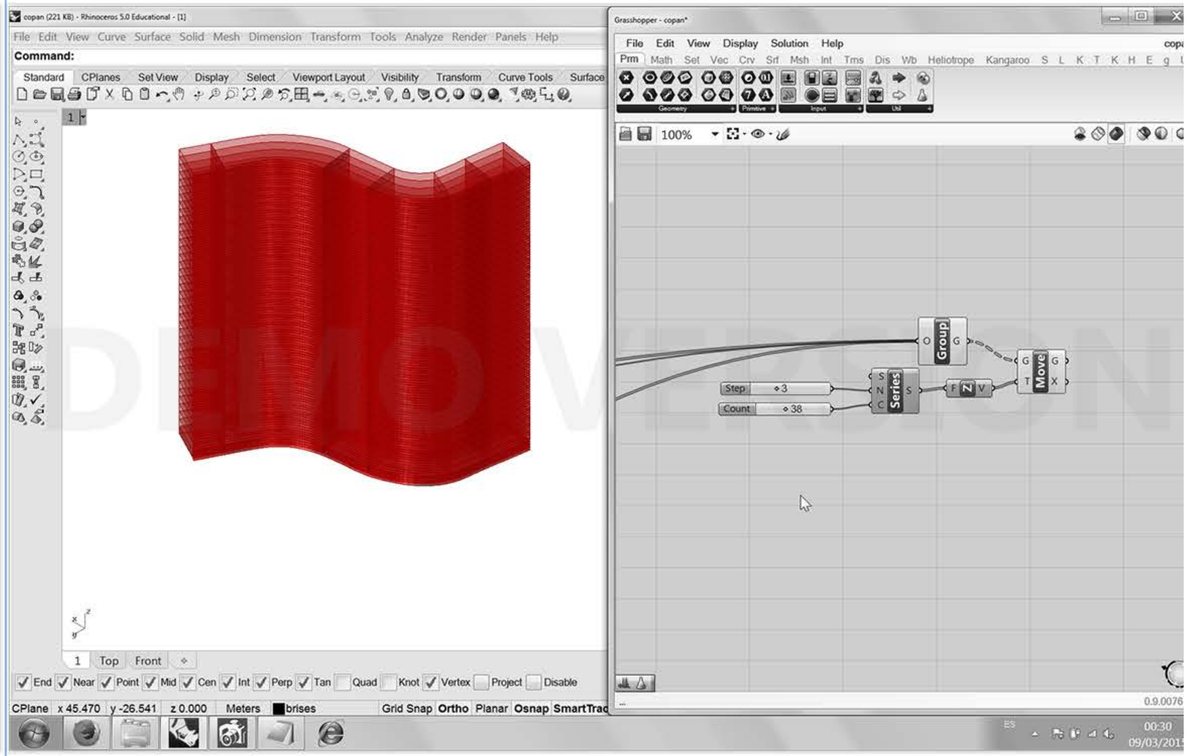


Connecting the list lenght of the vectors to the maximum values of the gradient and the exposure, without the Mass addition, so the values of each edge would be available, using the mesh colours component, the floor was painted by the value of exposure to the rays.



By making group, move and series component, the optimized floor was coppied 43 times, the current number of floors of the building.

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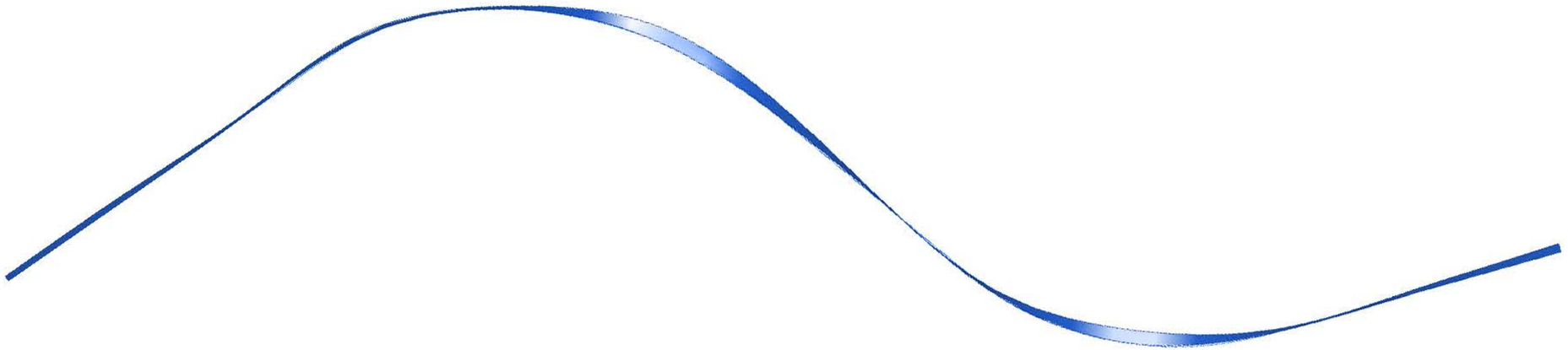

Optimized shading louvres for a typical floor
-
Front View

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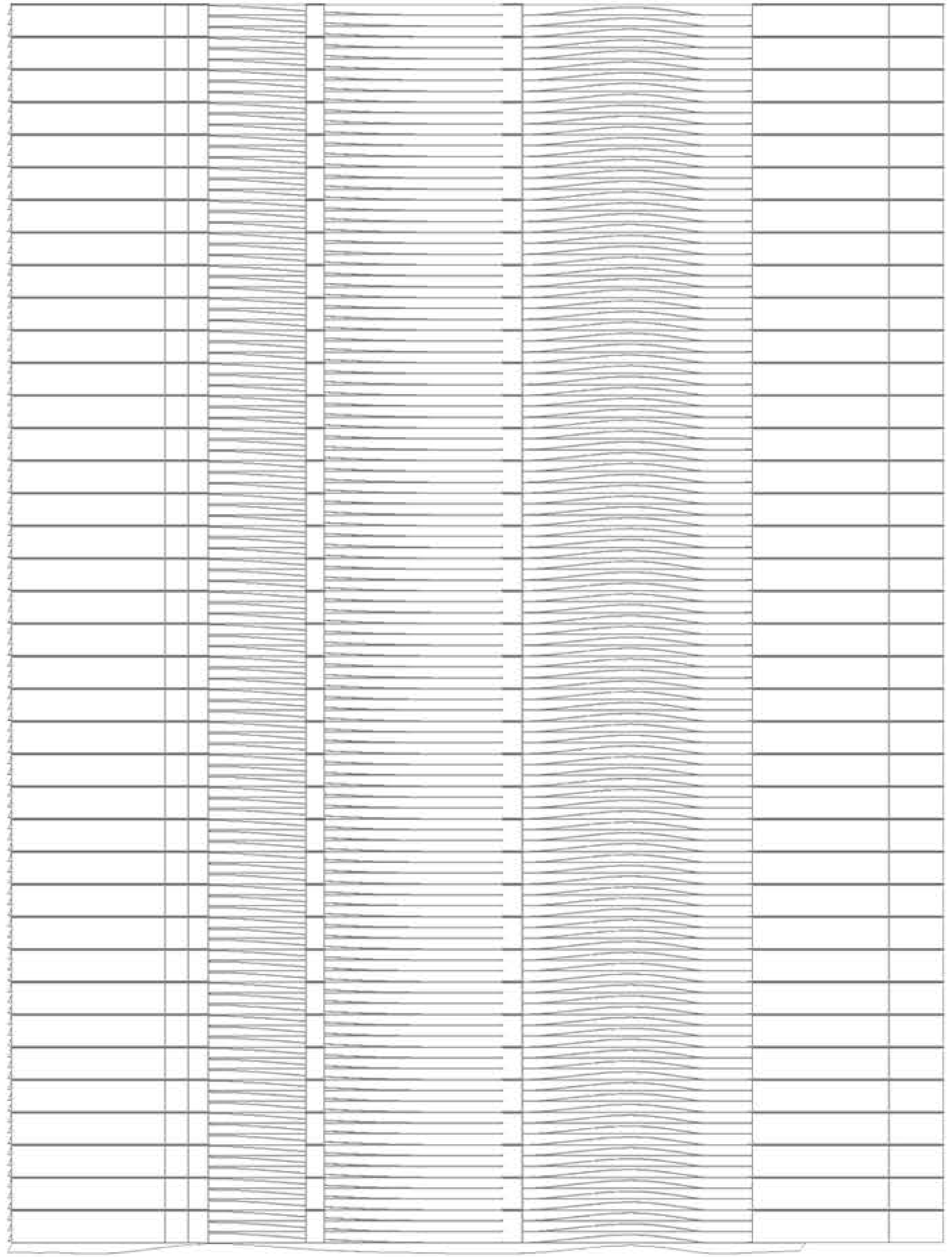
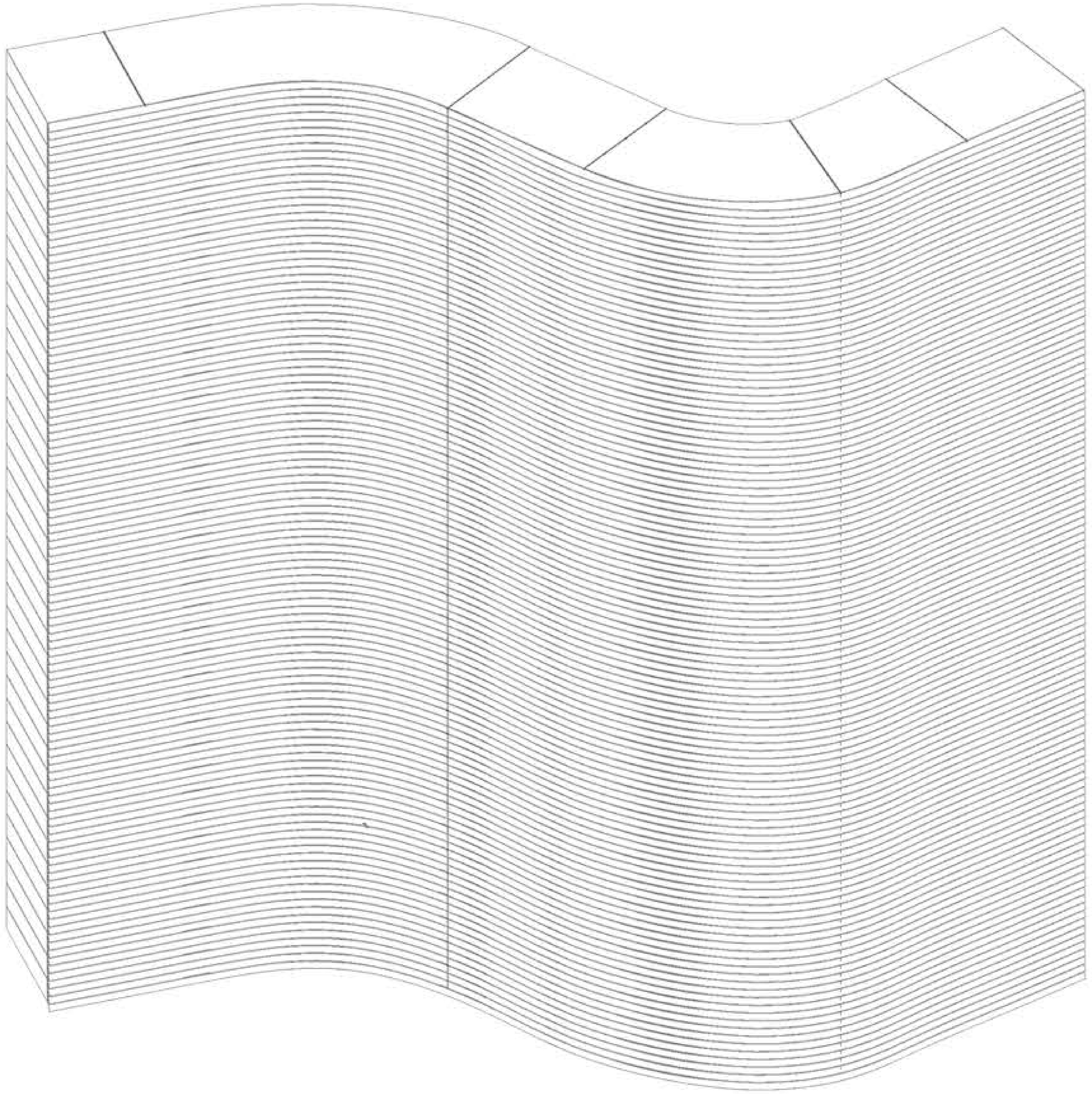


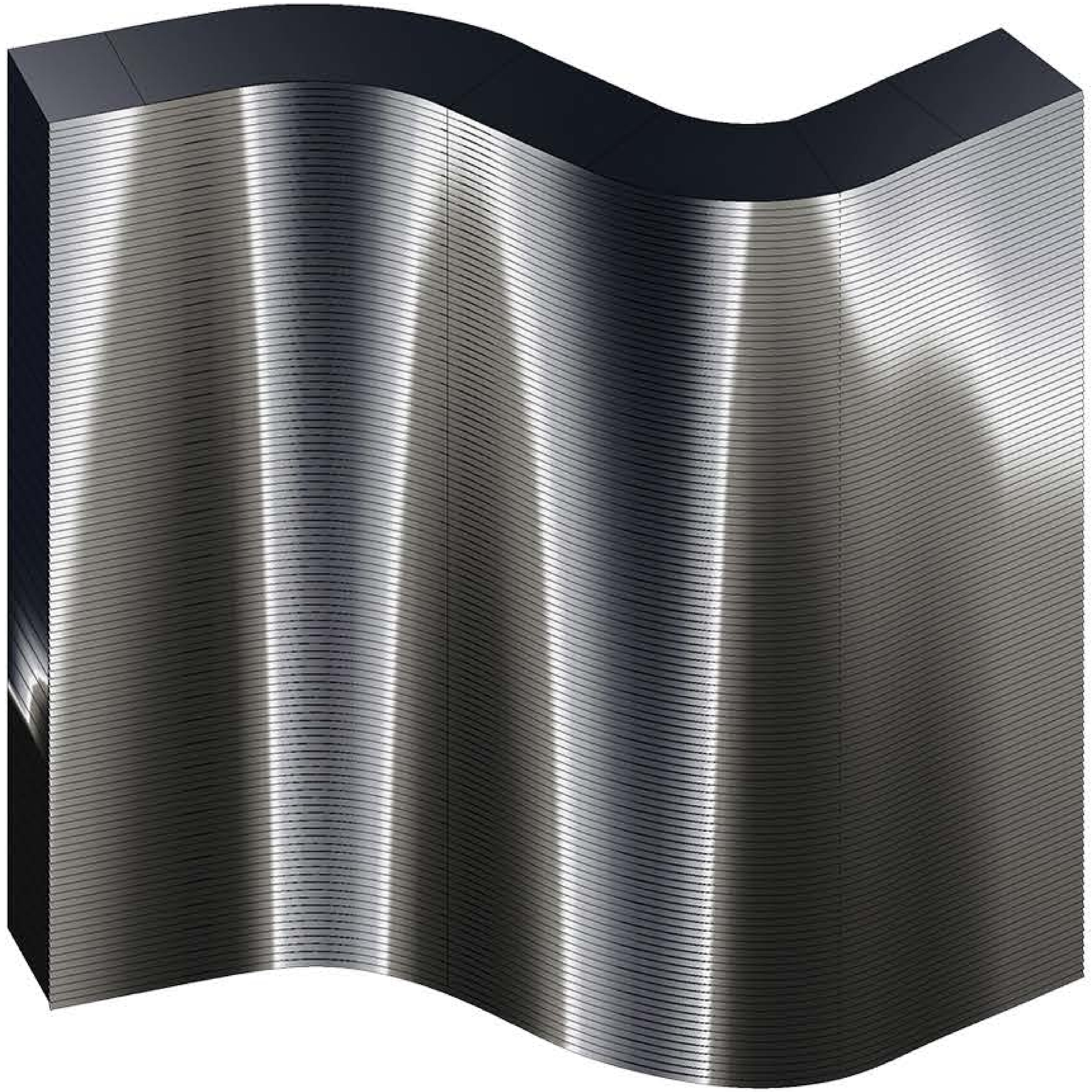
Optimized shading louvres for whole the building
-
Front View
-
Wireframe

Optimized shading louvres for whole the building
-
Front View
-
Rendered



Optimized shading louvres
for whole the building
-
Isometric View
-
Wireframe

Optimized shading louvres
for whole the building
-
Isometric View
-
Rendered



Optimized shading louvres
for whole the building
-
Perspective
-
Rendered

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