01-1 // Design Problem

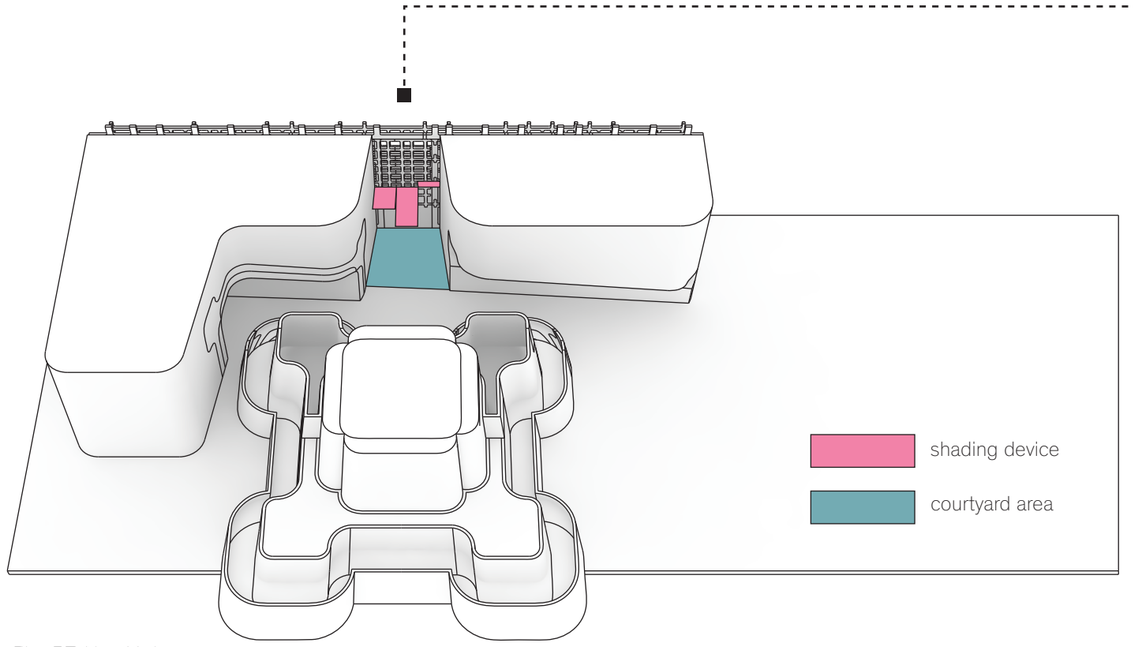
Our design proposal for the new Knoll Design Center +Offices consists of several courtyards aimed not only for the employees but also the public to enjoy such space for entertainment and networking. One of them is completely blocked by the three main buildings as well as huge screens and thus the amount of radiation getting onto the surface of the courtyard is in question. Since the site is located in the Hudson River on the west side of Manhattan in New York City which has distinct summer and winter seasons, we would like to have the minimum radiation in the courtyard during summer and the maximum radiation in winter.

01-2 // Anlytical Approach

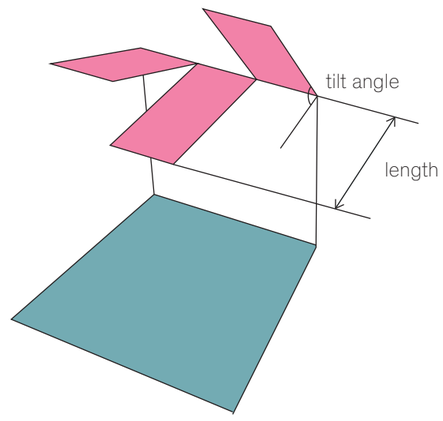
To solve the problem, we first assigned the area between the three buildings as the surface to be analyzed and deterimined the height of the shading device attached to the wall screen. In order to give more variation rather than single large shading device, we divided the shading device into 3 rectangular components and assigned different tilt angles. Since we wanted the courtyard surface to be analyzed in two different seasons, we first defined May to September as summer and December to March as winter and assigned them separately into Ladybug Analysis Period Tools.
For the analysis tool, we first started with Galapagos to find the optimization values without considering the scale of the shading devices; and then we used Octopus to optimize both radiations and the area of shading device.

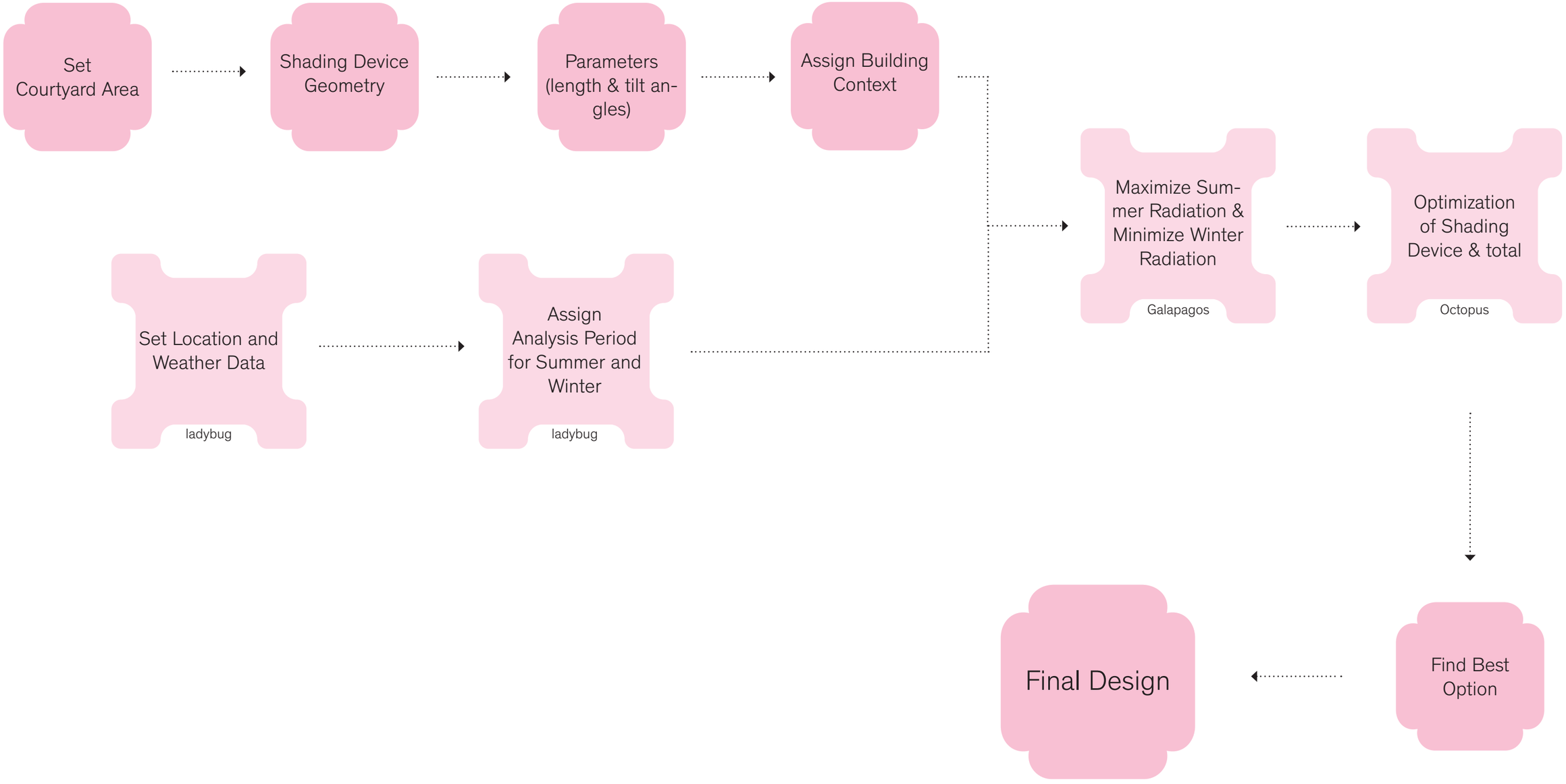
For Galapagos, we subtracted the total summer radiation from the total winter radiation and run the analysis to get maximum fitness per the variations of four parameters (length and 3 tilt angles of the device).

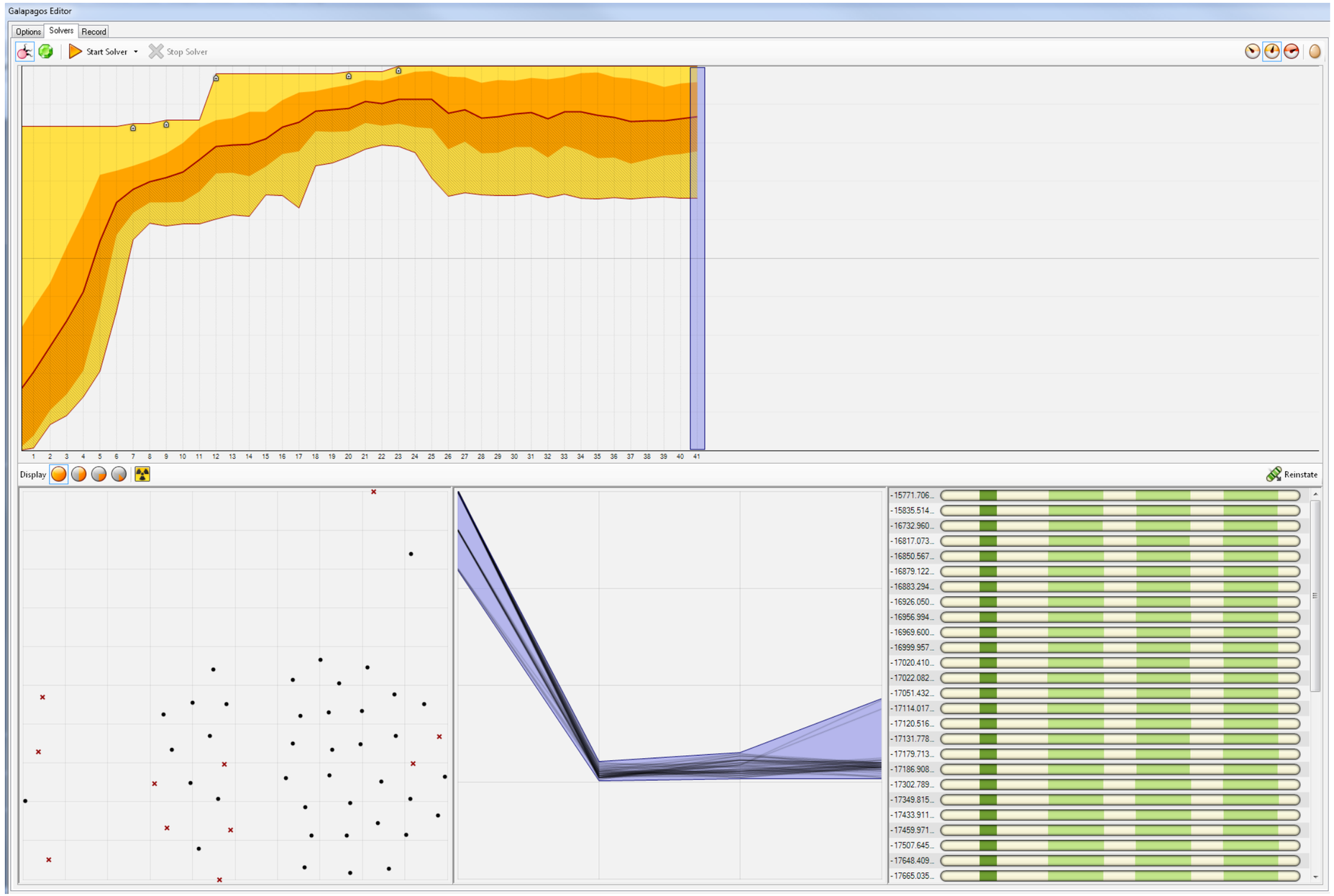
For Octopus, we combined the subtracted value from Galapagos analysis and the total area of shading device and ran analysis.



Pier 57, New York




Set Courtyard Area
Shading Device Geometry
Parameters (length & tilt angles)
Assign Building Context
Maximize Summer Radiation & Minimize Winter Radiation
Galapagos
Optimization of Shading Device & total
Octopus
Set Location and Weather Data
ladybug
Assign Analysis Period for Summer and Winter
ladybug
Find Best Option
Final Design



Final Result of Galapagos

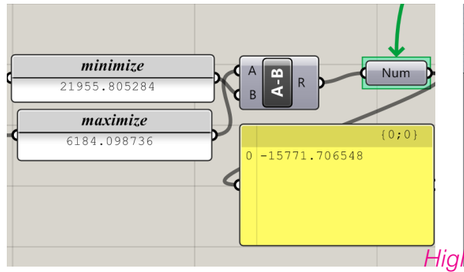
As we can see from the results of Galapagos analysis, the process continues untill it provides the optimized value, for our case, the maximum radiation in winter - minimum radiation in summer. However, as the area of shading devices was not taken into account during Galapagos optimization, at the maximum value, the genomes or the values of length and tilt angle does not change in great deal. Thus we concluded that we need to use run Octopus to achieve optimization of total radiation in two different seasons and the total area of shading devices.

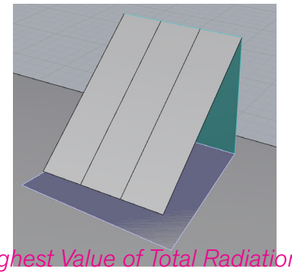
Genomes
(Length and Title angles)

Fitness
(Total Radiation in Summer and Winter)

Shading Device Apperance

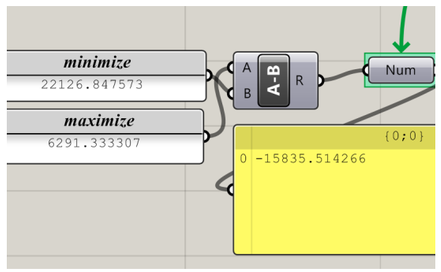
01

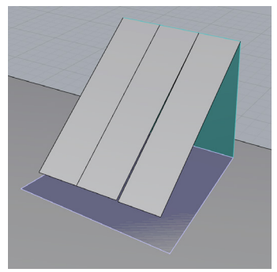




Highest Value of Total Radiation

02





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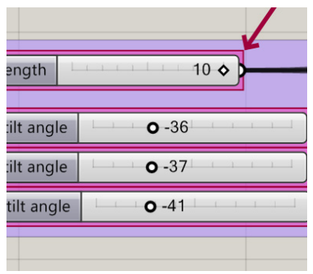

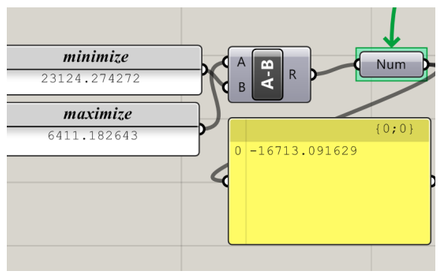

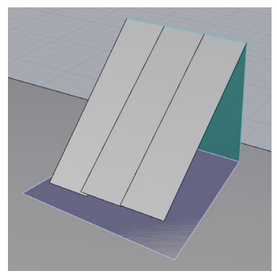

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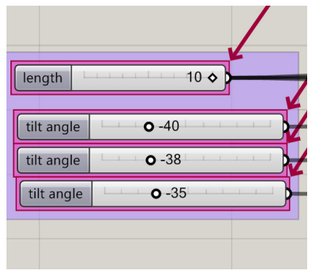

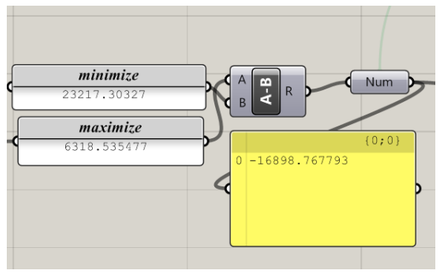

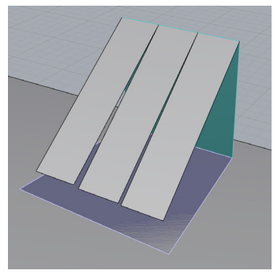

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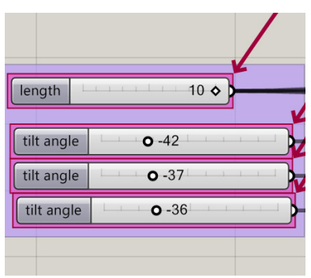
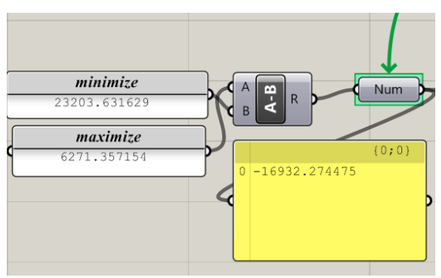
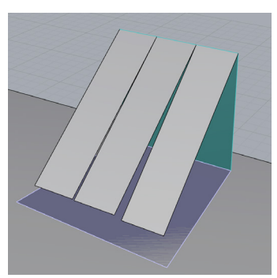




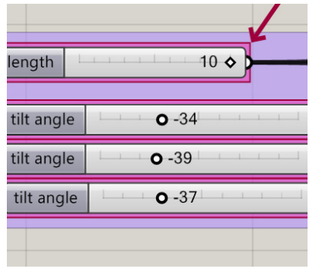


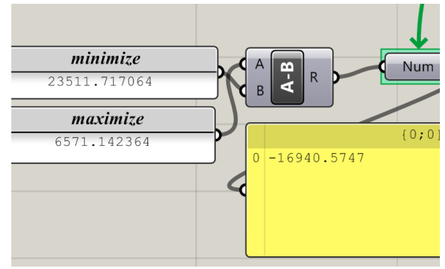
Genomes
(Length and Title angles)

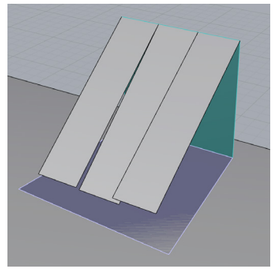
Fitness
(Total Radiation in Summer and Winter)

Shading Device Apperance

06







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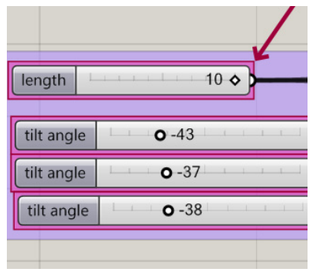

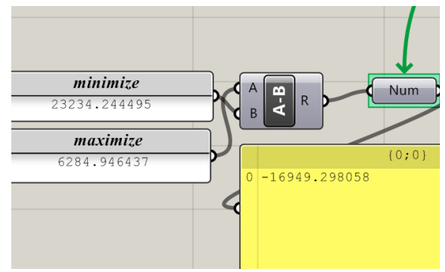

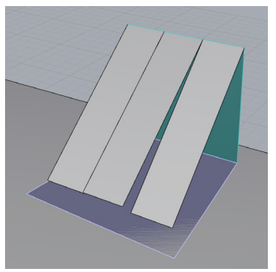

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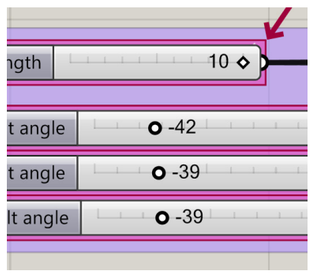

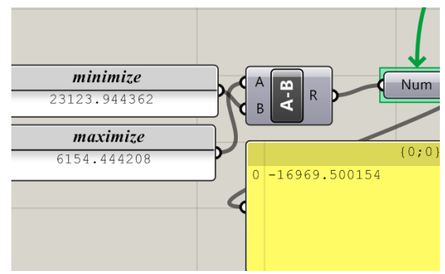

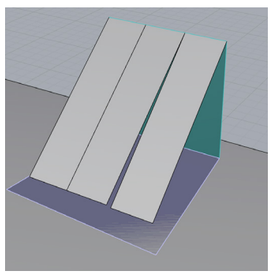

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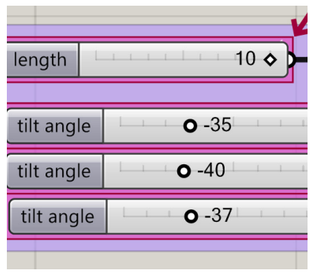

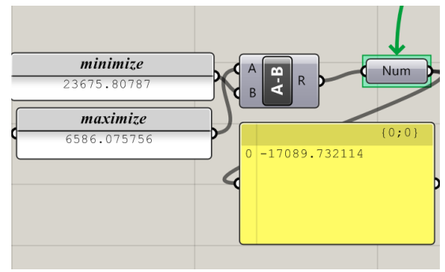

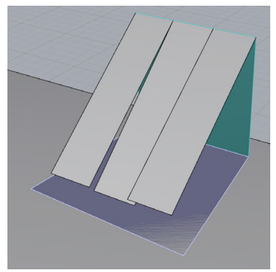

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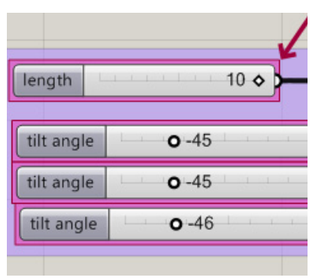

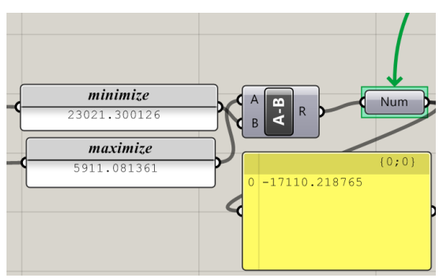

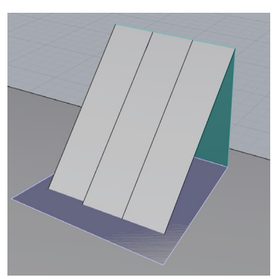

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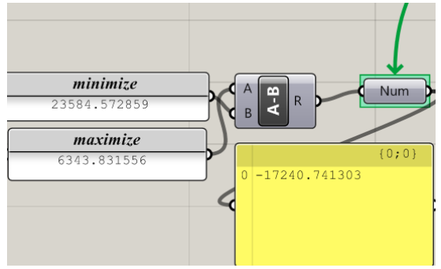
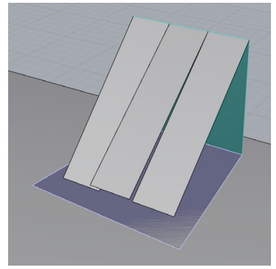
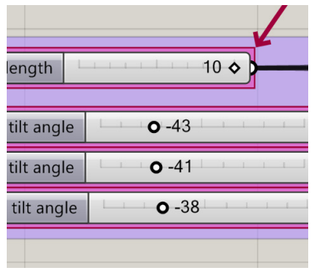
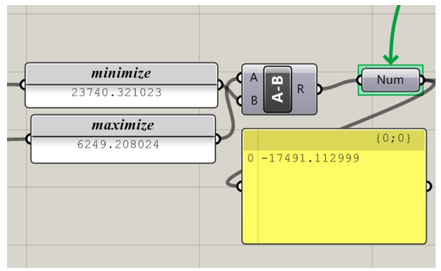
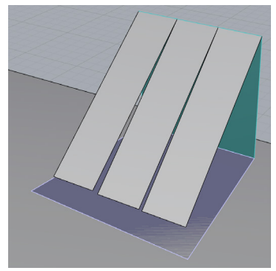
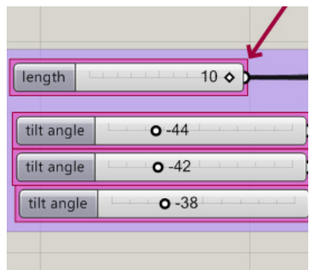
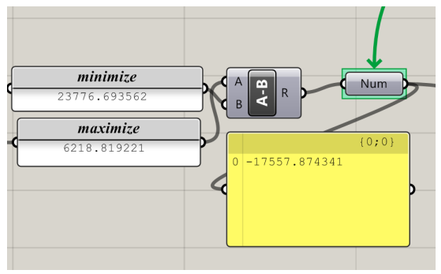
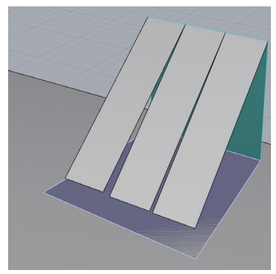
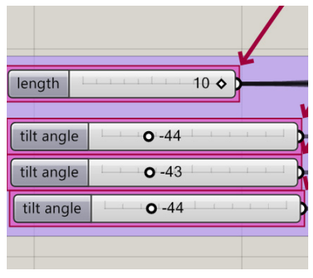
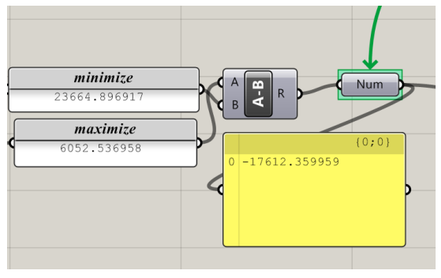
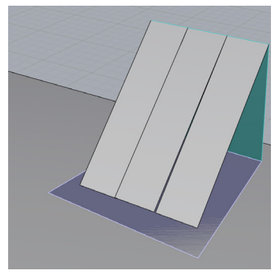
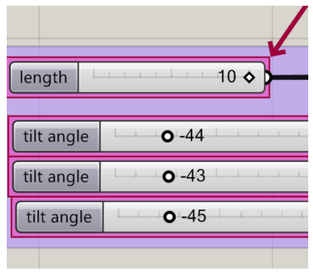
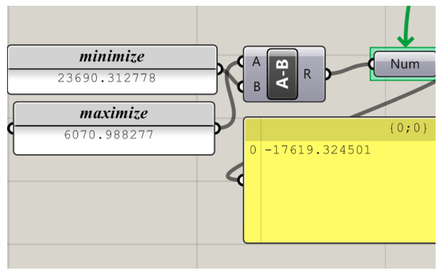
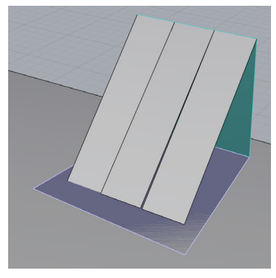
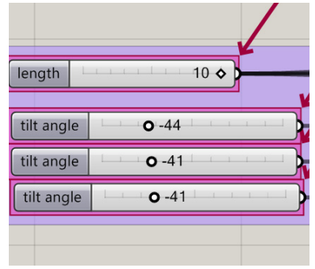
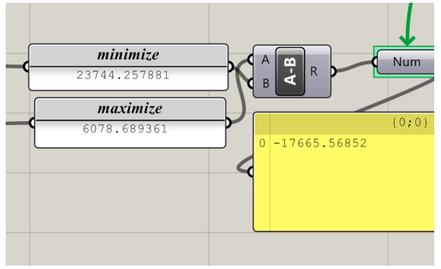
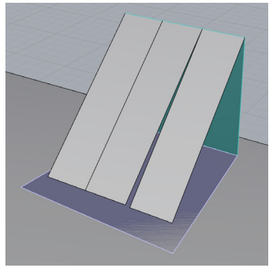
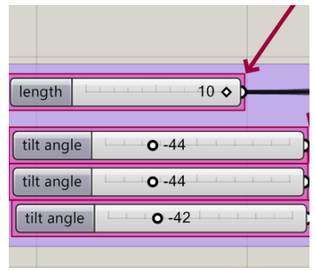
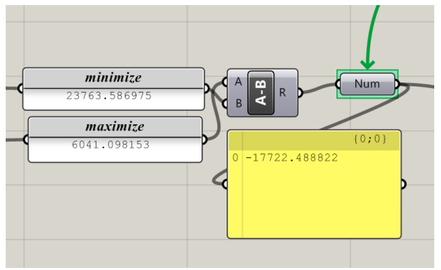
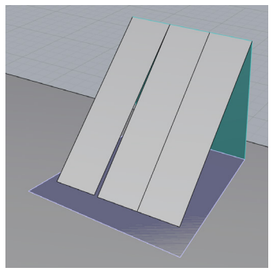
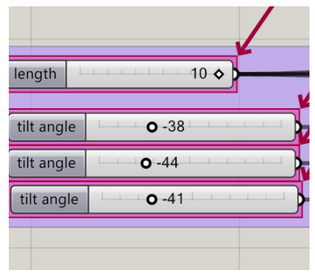
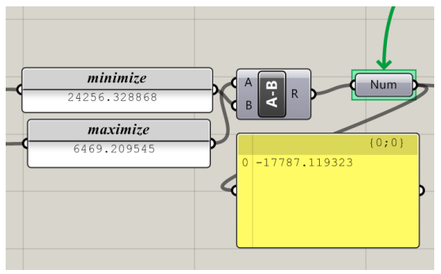
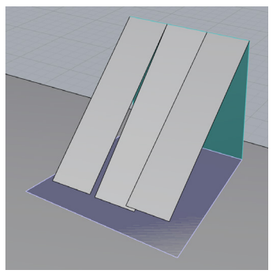
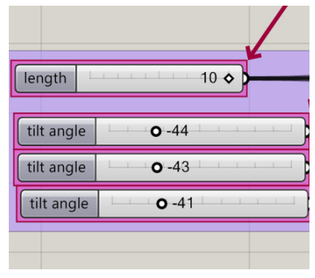
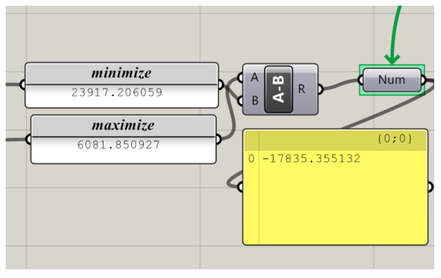
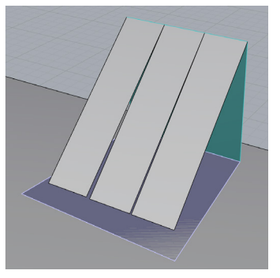
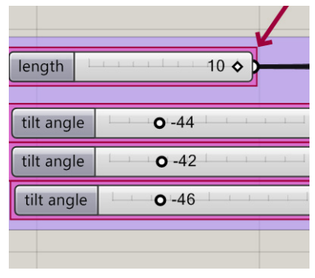
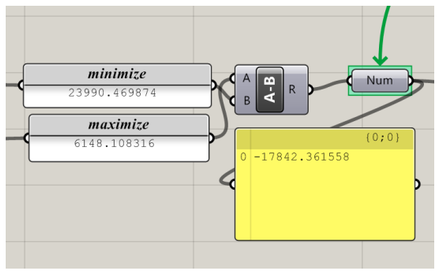
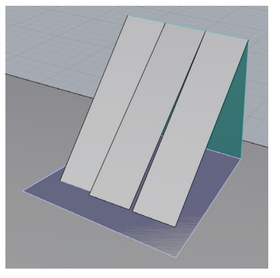
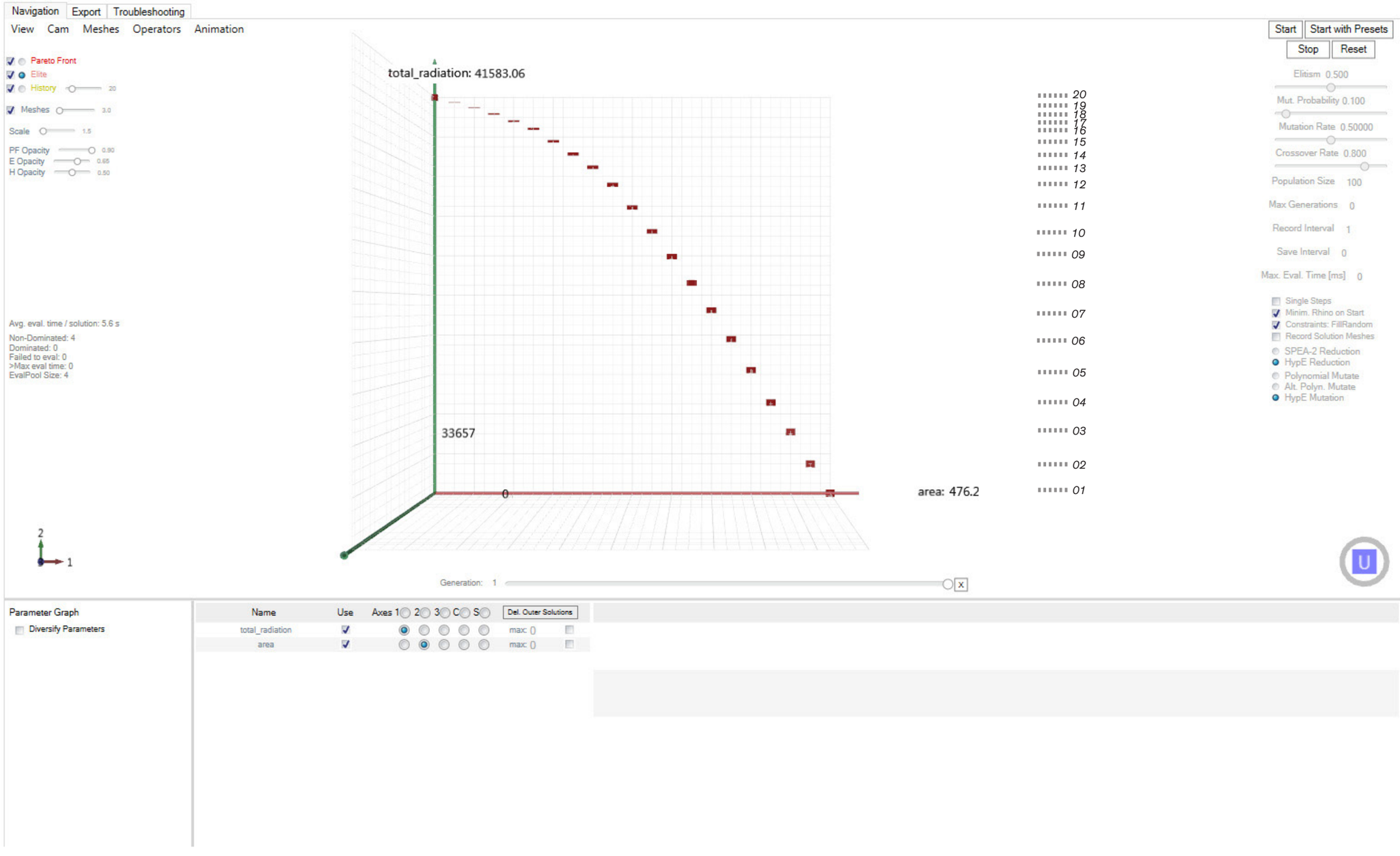
	Genomes (Length and Title angles)	Fitness (Total Radiation in Summer and Winter)	Shading Device Apperance
11			
12			
13			
14			
15			

	Genomes (Length and Title angles)	Fitness (Total Radiation in Summer and Winter)	Shading Device Apperance
16			
17			
18			
19			
20			



Final Result of Octopus

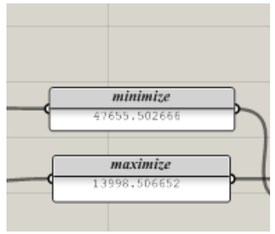
When shading device's area is decreasing, the total radiation (absolute value of "minimum radiation of Summer - maximum radiation of Winter") is increasing. The best way to achieve our goal is to choose the highest value of total radiation. However, if there is another consideration, minimizing area of shading space, the best result could be on middle points of the graph, #9-12.

Total Radiation (Summer - Winter)

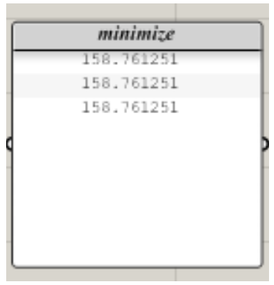
Shading Device Area

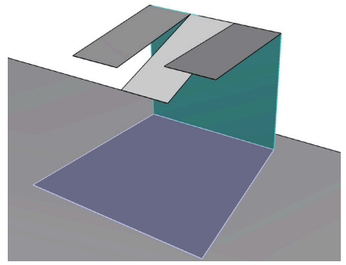
Shading Device Apperance

01



33,657





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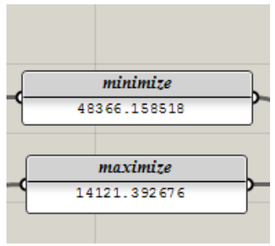

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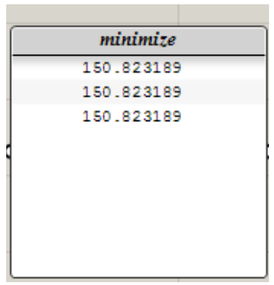

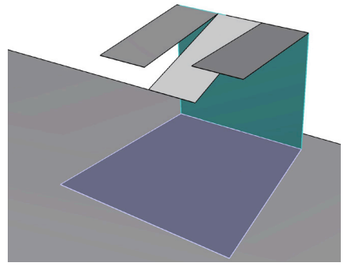

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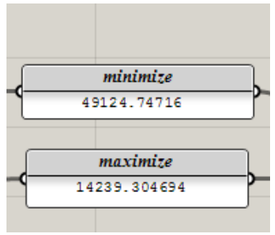

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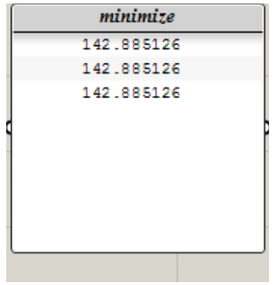

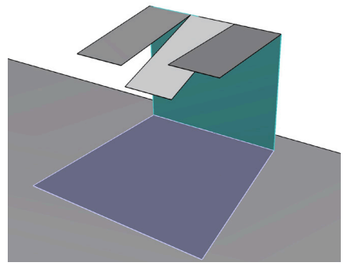

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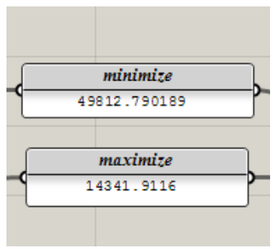

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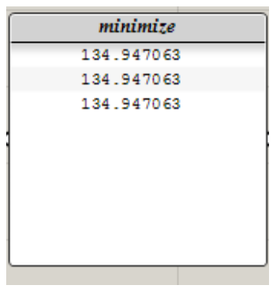

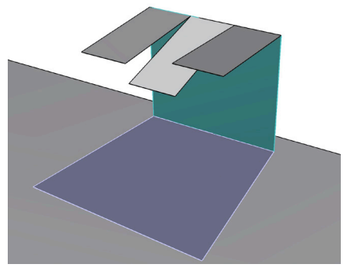

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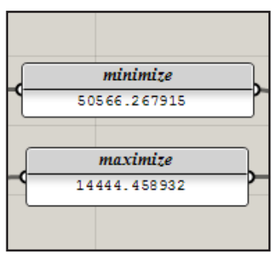

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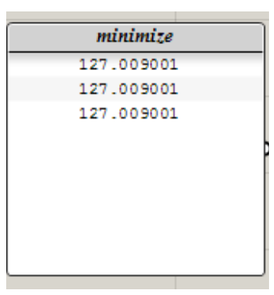
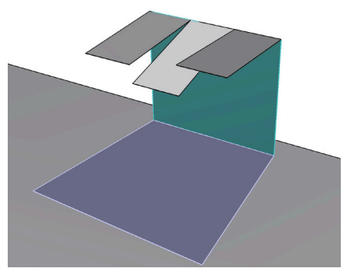


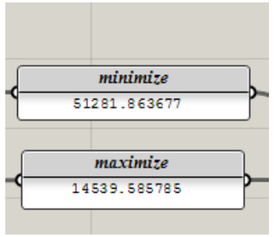


Total Radiation (Summer - Winter)

Shading Device Area

Shading Device Apperance

06



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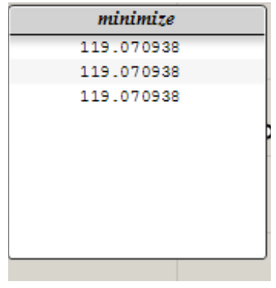

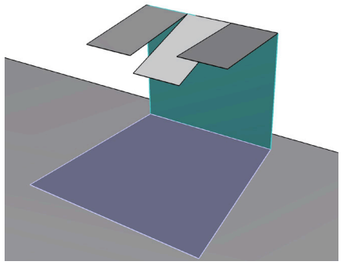

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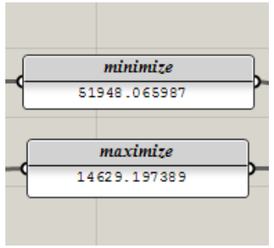

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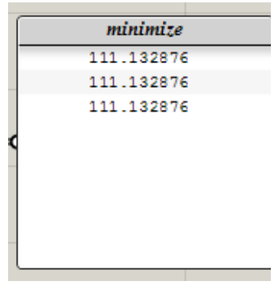

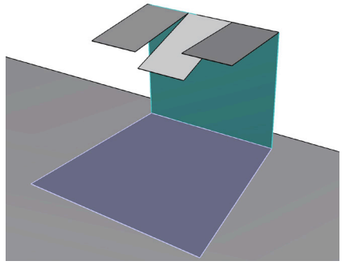

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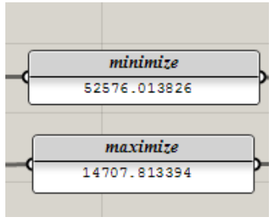

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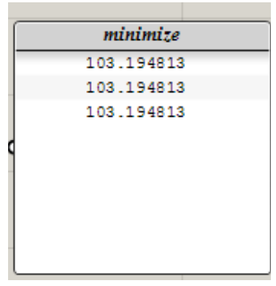

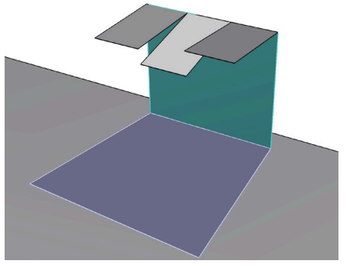

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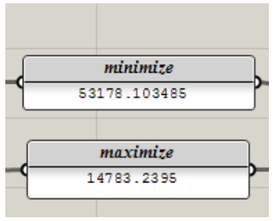

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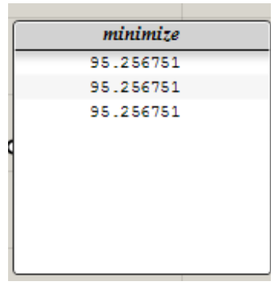

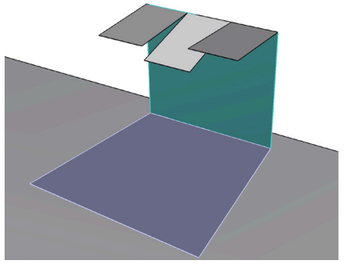

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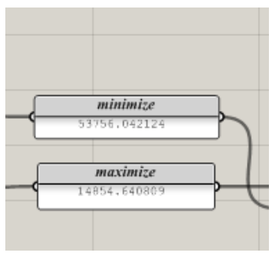

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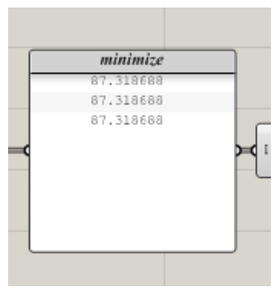
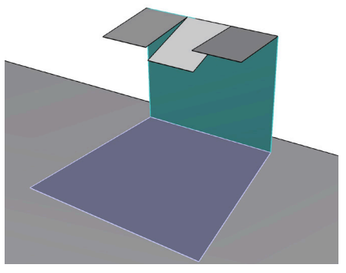
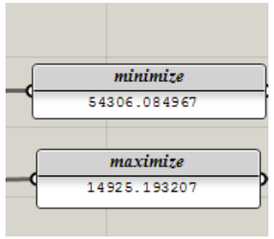
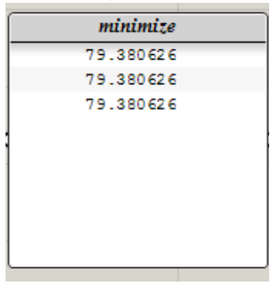
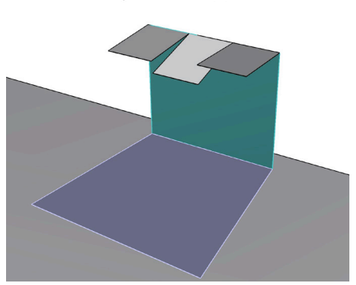
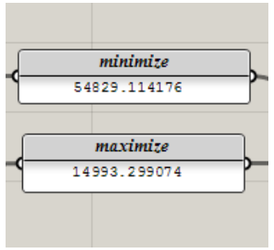
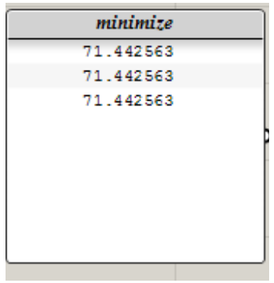
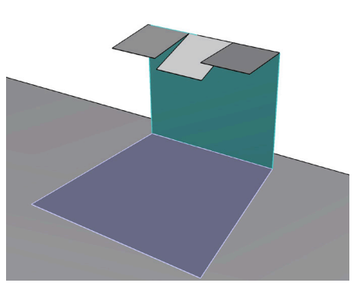
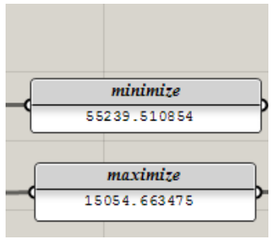
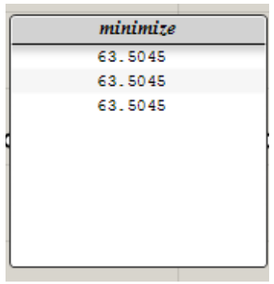
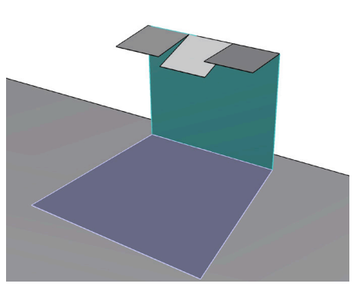
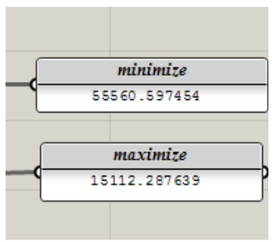
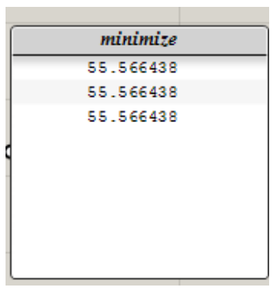
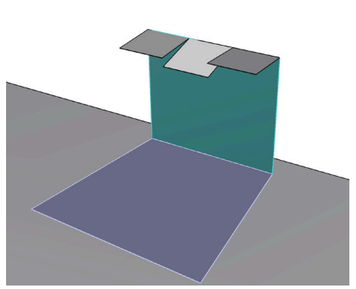
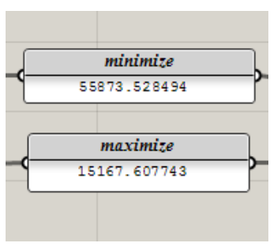
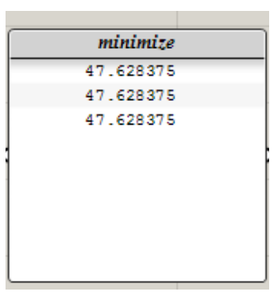
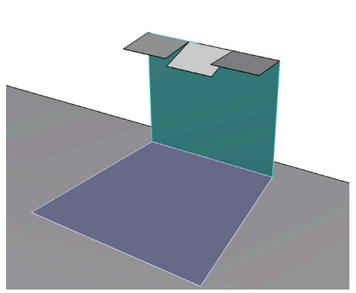
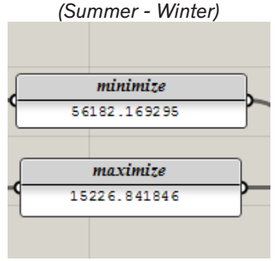
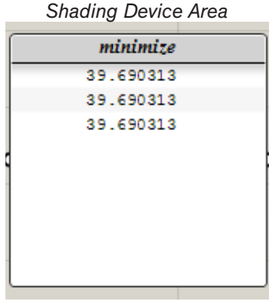
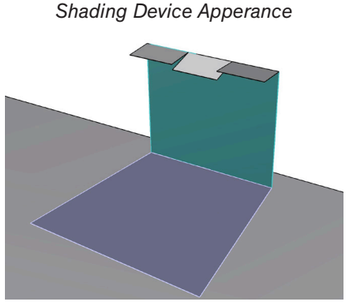
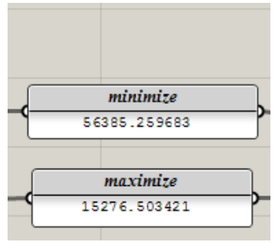
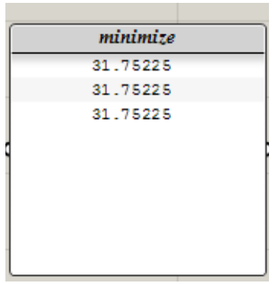
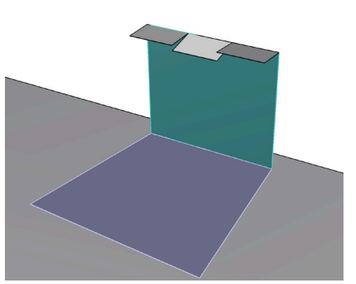
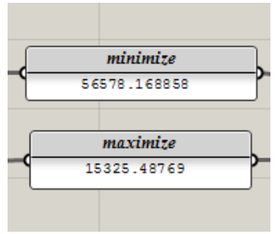
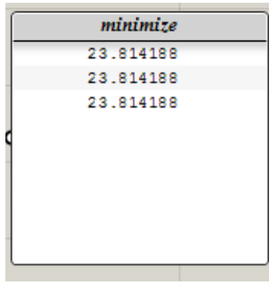
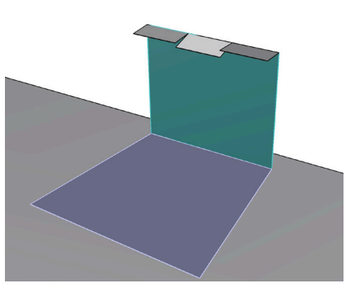
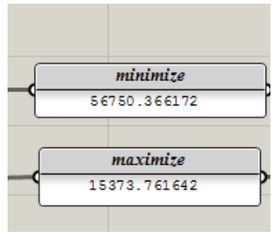
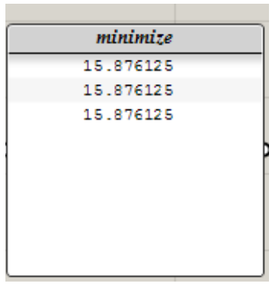
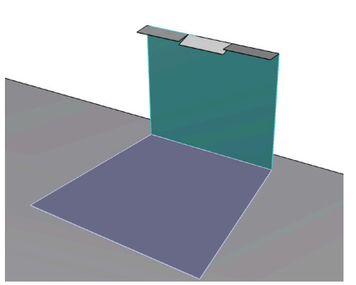
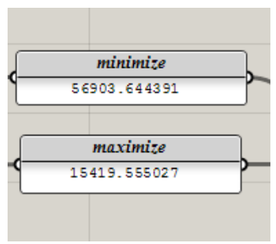
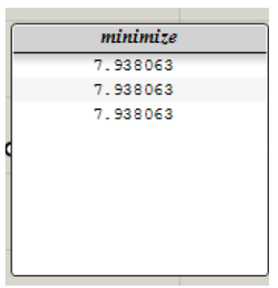
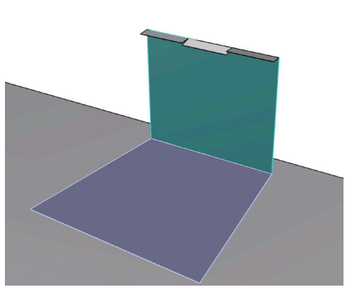




	Total Radiation (Summer - Winter)	Shading Device Area	Shading Device Apperance
11	 39,381		
12	 39,836		
13	 40,185		
14	 40,448		
15	 40,706		
16	 40,956		
17	 41,109		
18	 41,253		
19	 41,377		
20	 41,484		

Highest Value of Total Radiation