Investigations in Heliostats and Modelling

Digital Design Applications Studio

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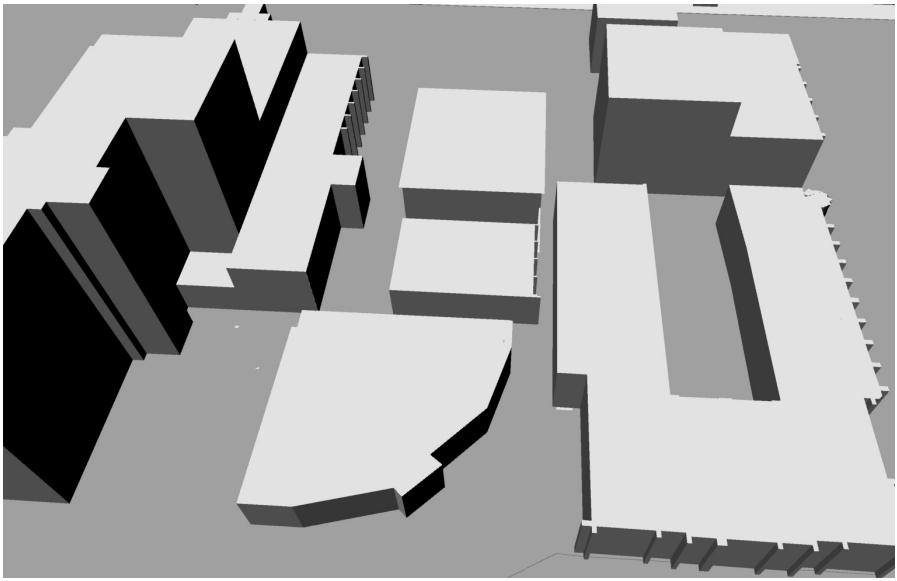
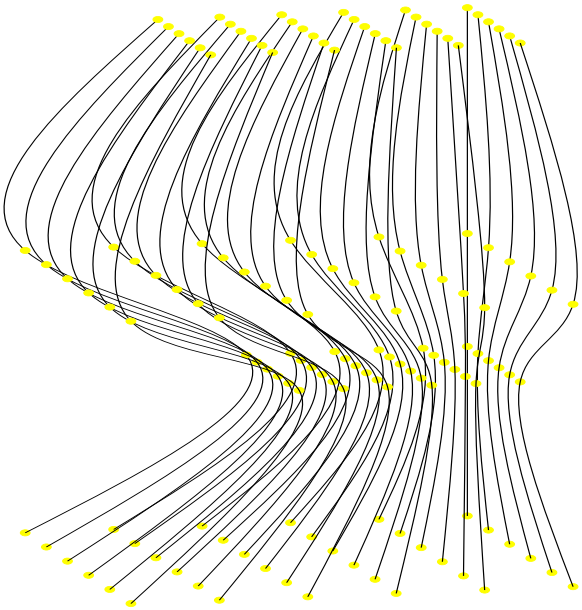
This investigation calls for an architectural insertion into a much used public thoroughfare between the Physics Building and the Elizabeth Murdoch Building at the University of Melbourne. The portion of the link being used is only 2.4m wide, with its flanking buildings being alternately 6, 8 and 12m high.

The investigations looks at initially movement through the space and the role of algorithmic functions in these. The definition of a parametric surface is then used as the starting point for creating a makeshift heliostat, reflecting light down into the space.



The first step looks at tracing multiple paths through a space using a function which threads BSplineCurves along multiple point grids.



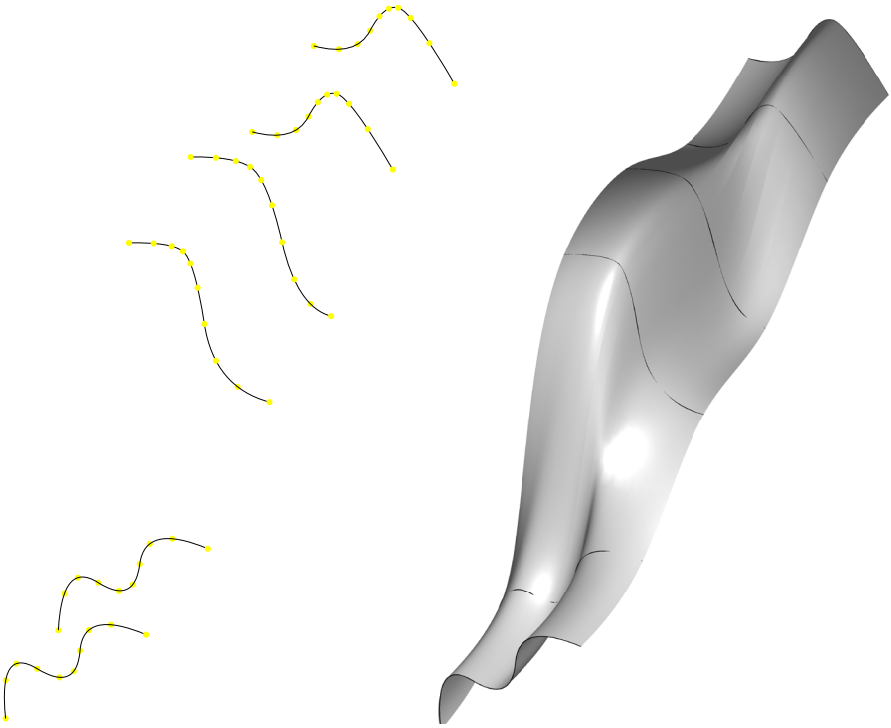
```
function (Point ptGrids)                                    input arguments are a list of point grids
{
   BSplineCurve funCurve = {};
   for (int i = 0; i < ptGrids[0].Count; i++)               i = counts the number of point grids in initial argument
   {
      funCurve[i] = {};
      for (int j = 0; j < ptGrids[0][0].Count; j++)         j = the position in the first (and subsequent) point grids (which is a
      {                                                     list of points)
         Point tempPts = {};                                tempPts is a list of points through which to make each BSplineCurve
         for (int k = 0; k < ptGrids.Count; k++)            k = the position of the point in the list [j] within the ptGrid [i]
         {
            tempPts[k] = ptGrids[k][i][j];                  tempPts = a point in the lists. [k] - the position in the list [j], which
         }                                                  is a position in the list [i]
         funCurve[i][j] = new BSplineCurve();
         funCurve[i][j].ByPoints(tempPts,false);            creates a BSplineCurve through all the temp points [k] in a specific
      }                                                     [i] and [j] position
   }
   return funCurve;
}
```

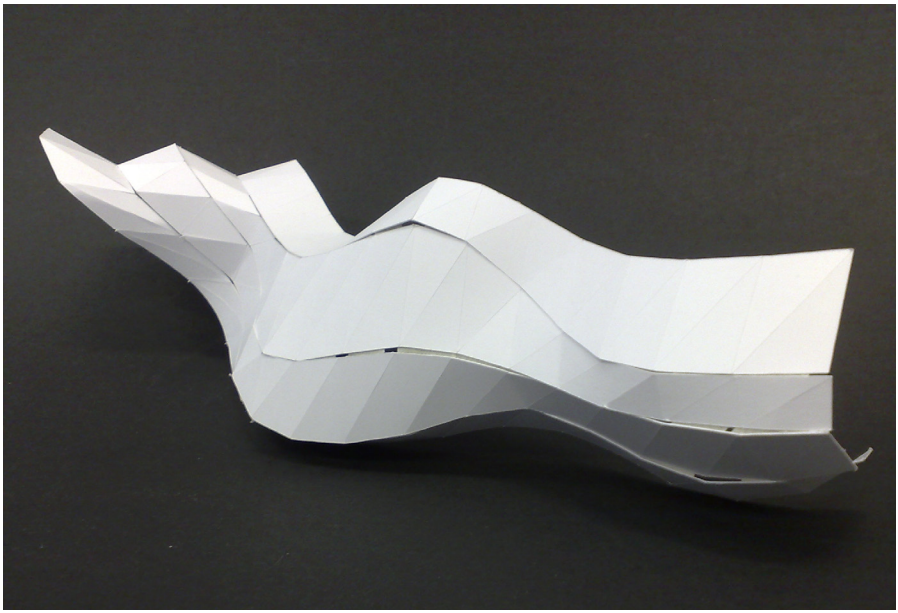
Surface Study

In order to create a manipulatable surface a series of sectional cuts are created through which a surface is applied.

The BSplineSurface acts as a double curve and can be constructed using unfolded card.

The process of translating the smooth surface into polygons for manufacture allows for further devolpment of each polygonal instance.

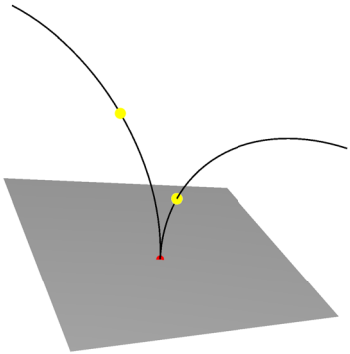


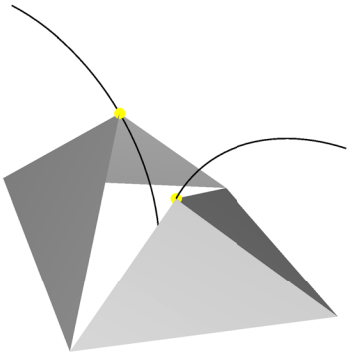


Opening Component

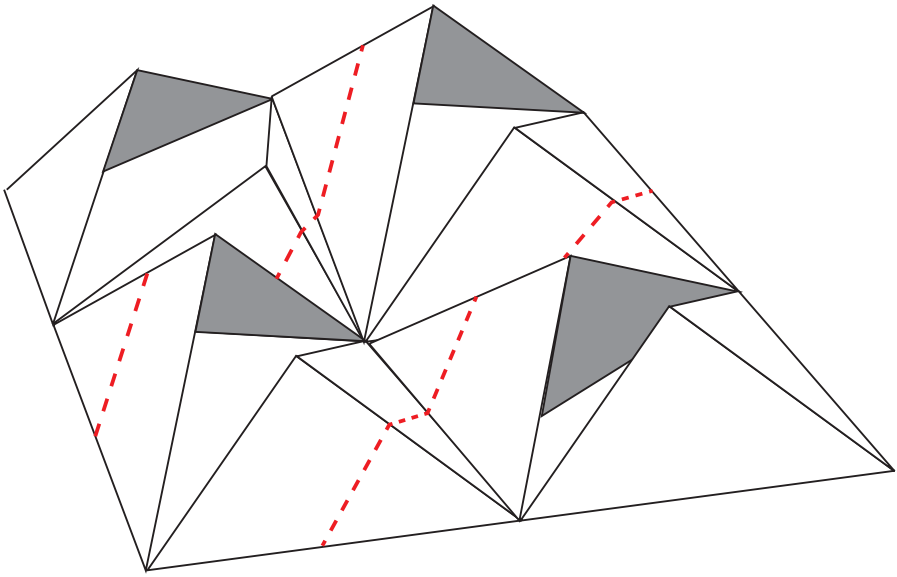
Considering the surface as a series of polygon instances a component is created to allow varying levels of sun through the surface.

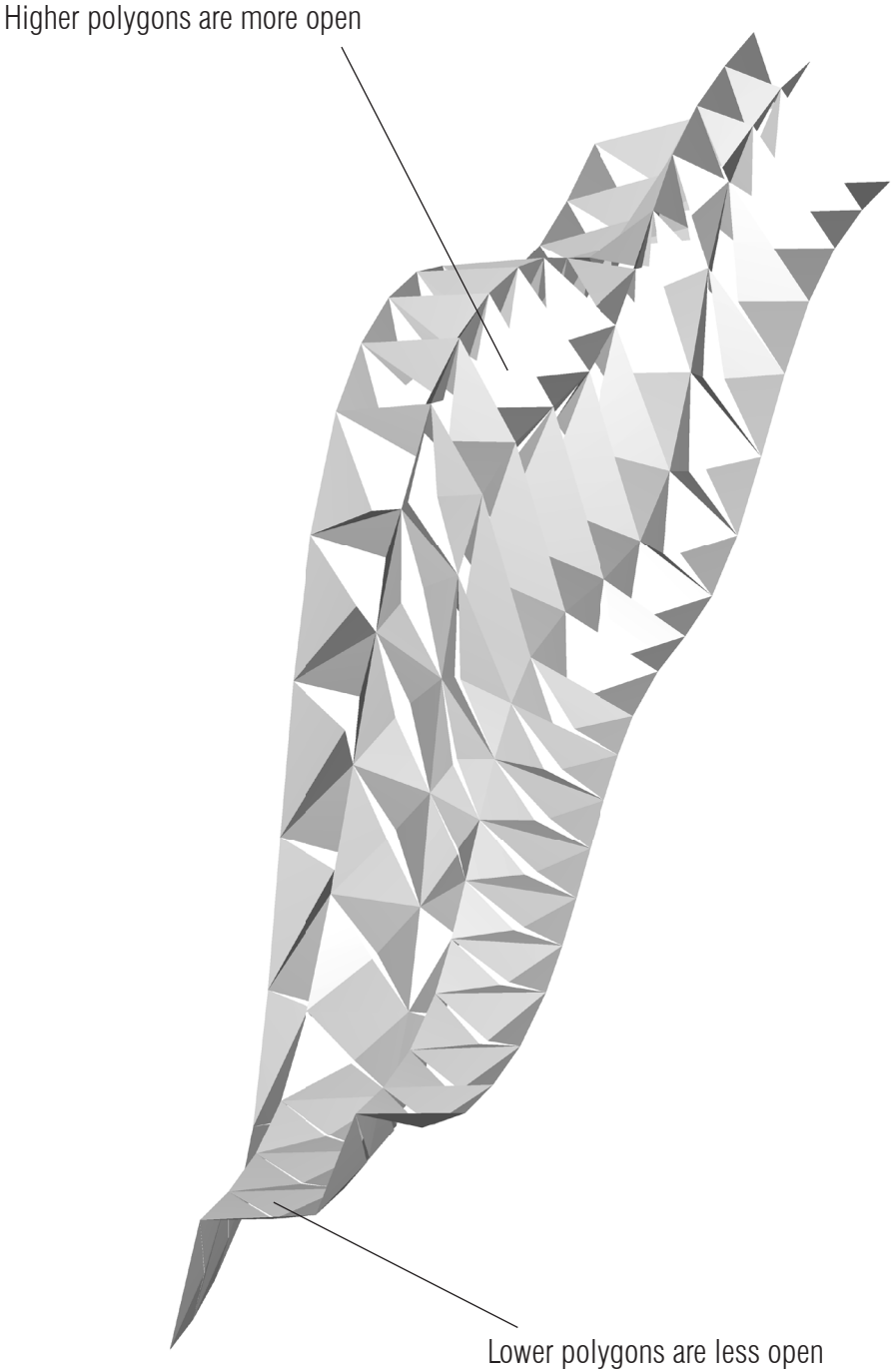
The component is designed such that the polygon is divided diagonally and then folded up along an arc depending on the polygon's mid point. The higher the mid-point of the polygon the larger the opening of the component.

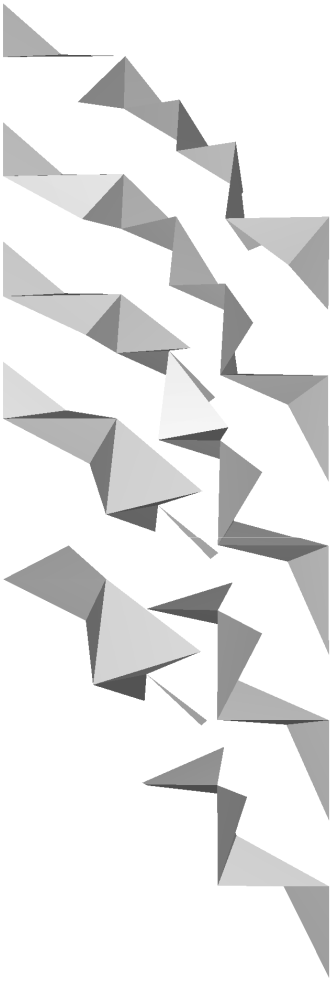




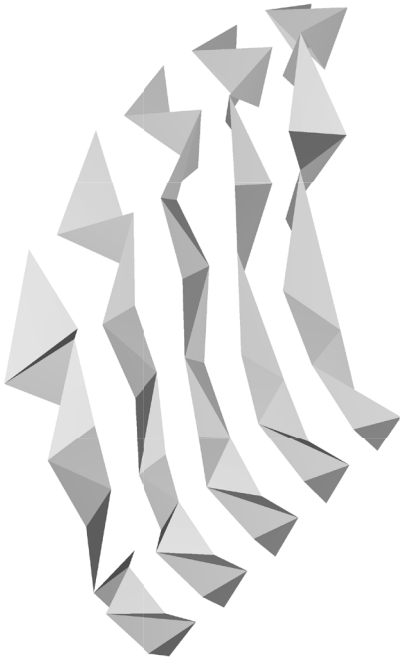
The diagonal division of the component allows the repeated unit to connect to istelf and allow for unfolding of a single surface diagonally arcoss the orignal sruface.



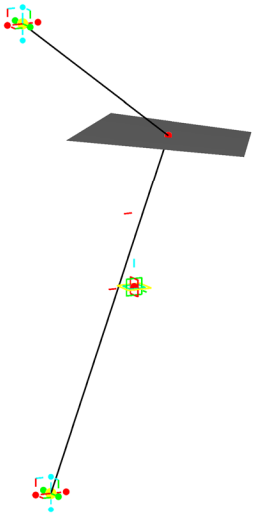

Higher polygons are more open
Lower polygons are less open

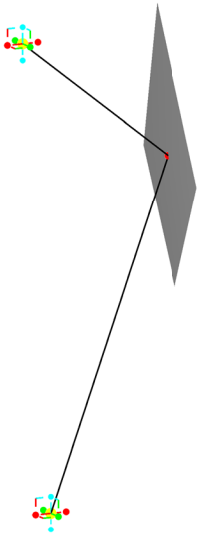


Applied to the surface a simple folded strips can be made through the propogation of the component.



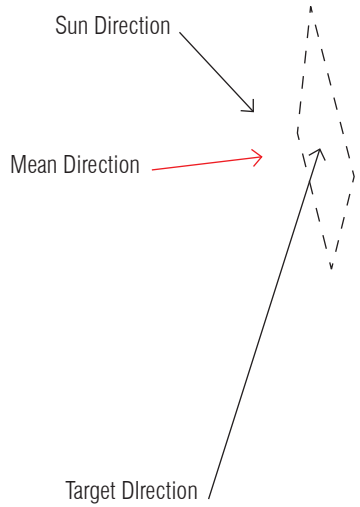
Reflective Component





A component was developed that looked to reflect light to a particular point, rather than act as a shading device.

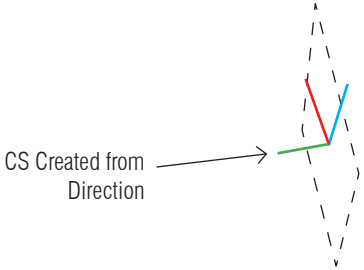
In order for the reflective polygon to be produced a series of relationships were devised.



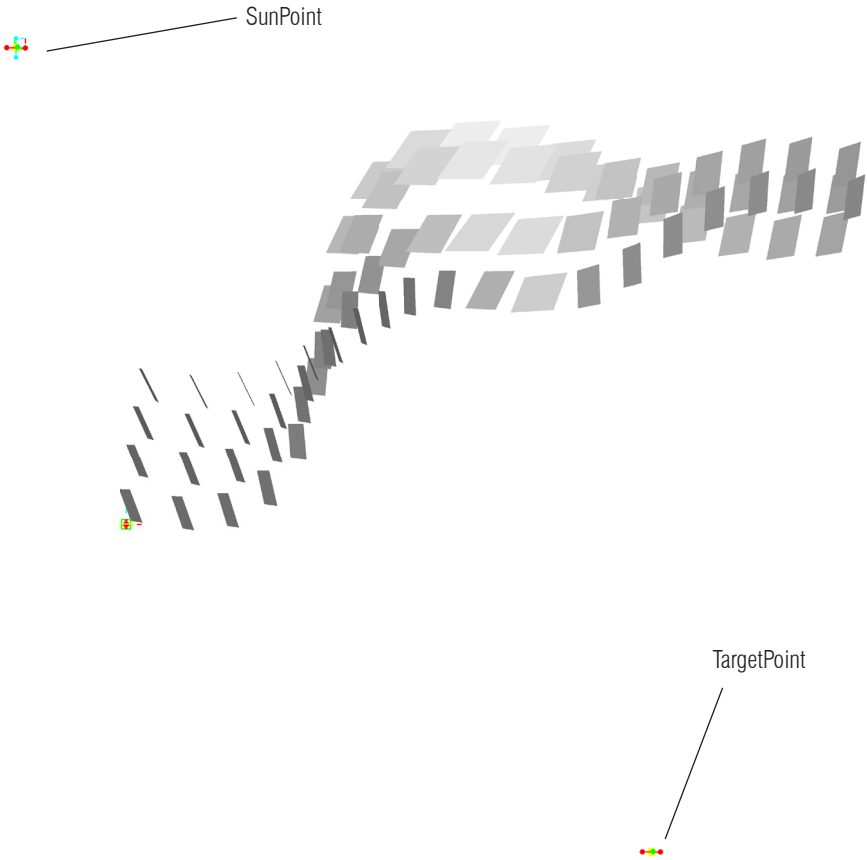
A sun direction is given from a SunPoint to the BaseCS.

A desired angle of reflection is given as a direction from the centre point fo the polygon to the TargetPoint.

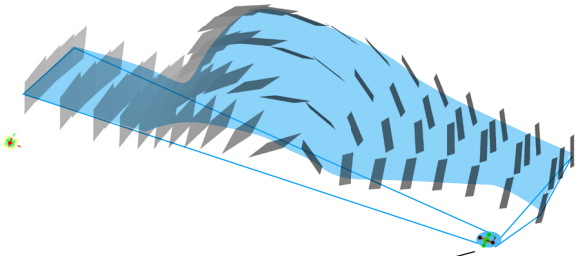
The average direction of the two above gives a direction perpendicular to the required reflection plane.



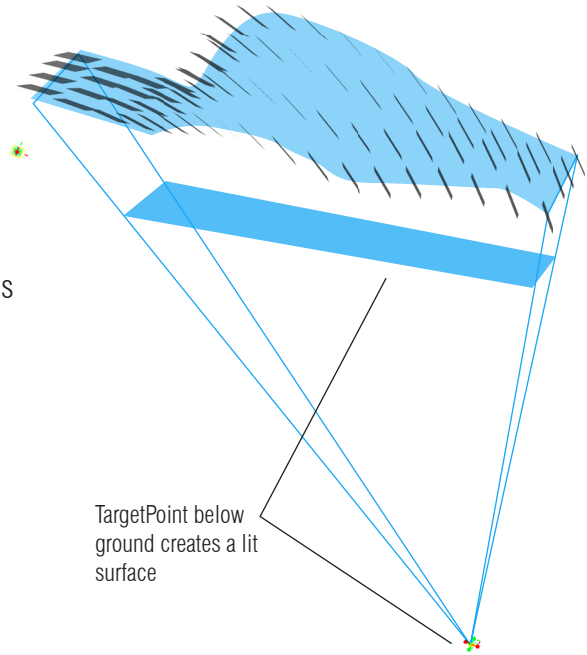
A new CS is created on which the polygon can be drawn.



The component is applied to the Polygon Surface to create a SuperHeliostat



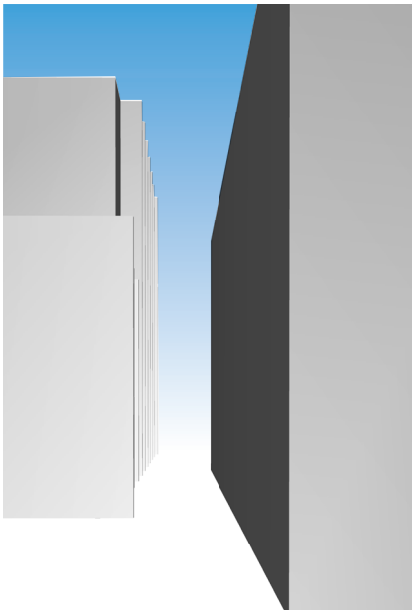
TargetPoint on ground plan creates a point light.



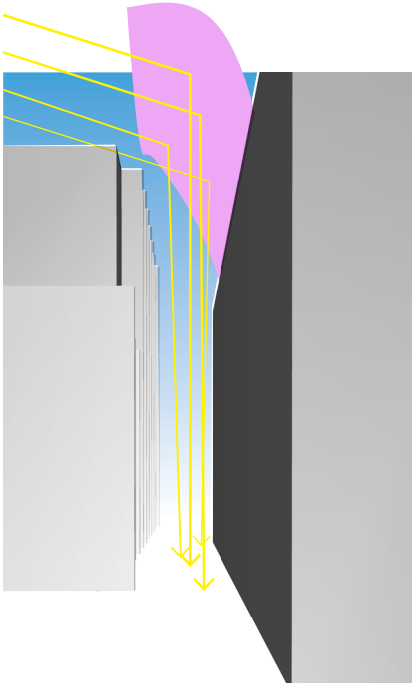
Moving the target point below the ground plane creates a wider range of lit surface.

TargetPoint below ground creates a lit surface

Adapting to Site

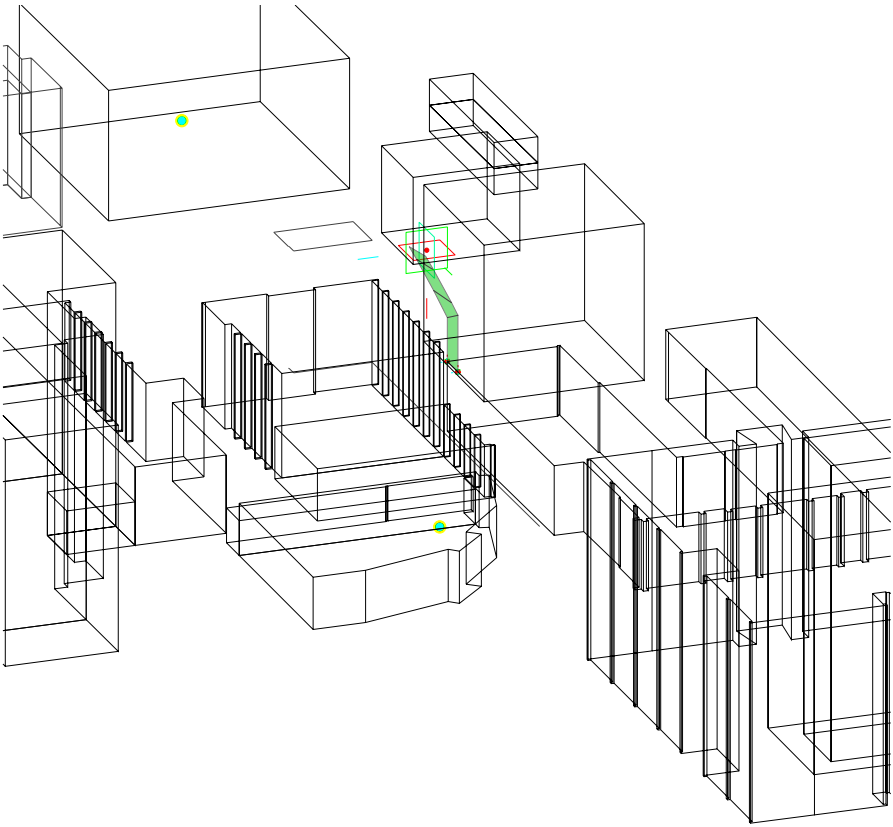


In order to create a function heliostat on site it is evident that singular components must be developed that are constructable and repeatable.

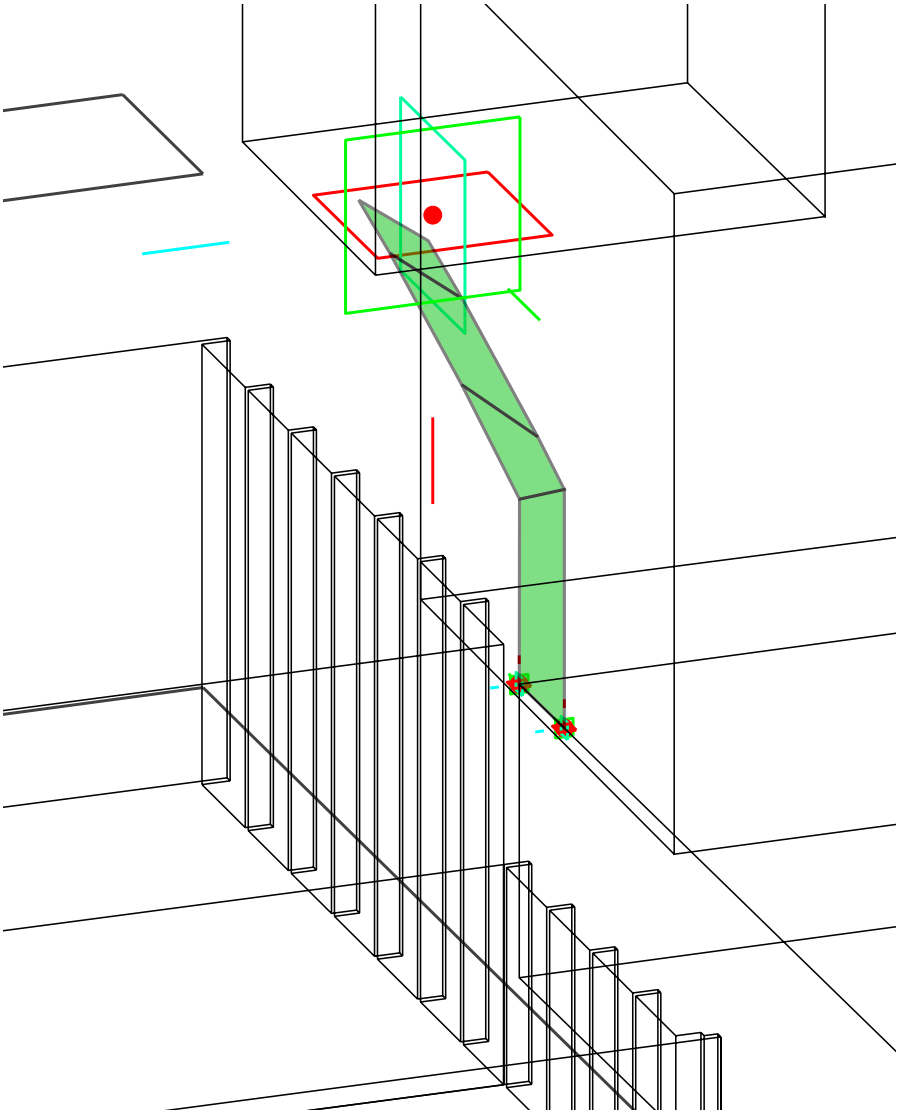


The princple of the installation is to illuminate the narrowest part of the alley from the northern sun typically shaded by the Physics Building.

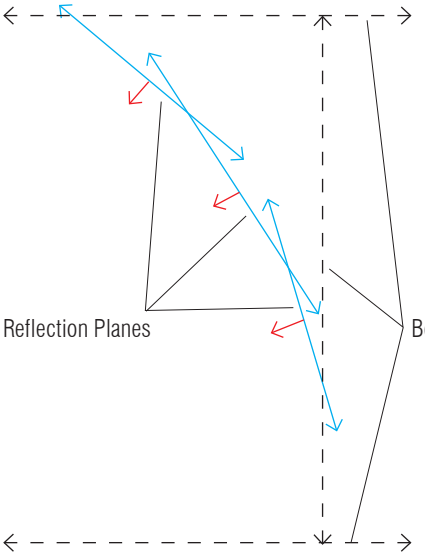
A singular component is develop as a large light scoop for study of effects of moving control points and fabrication methods.



The component is constructed from a series of planes and directions whose intersections create polygonal shapes on three reflective planes.

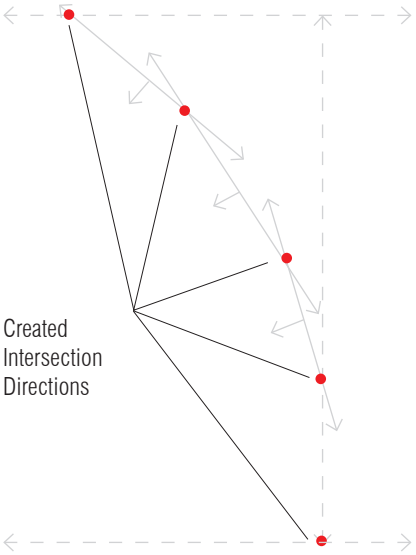


Creating the Component



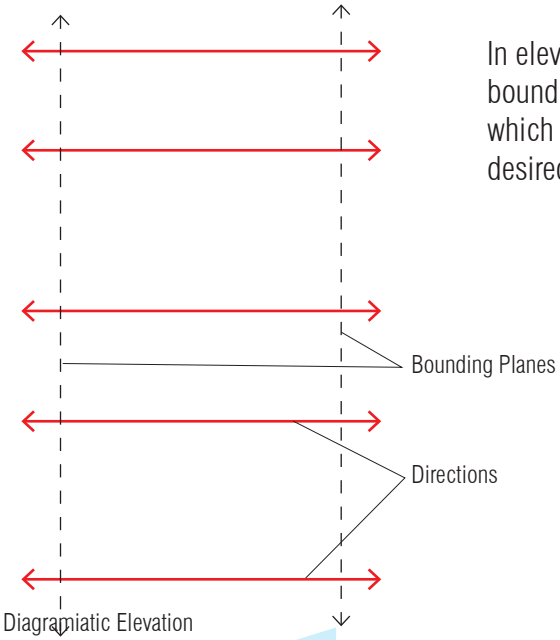
Diagramiatic Section

Three infinite planes are created on different reflective points using generated CoordinateSystems.



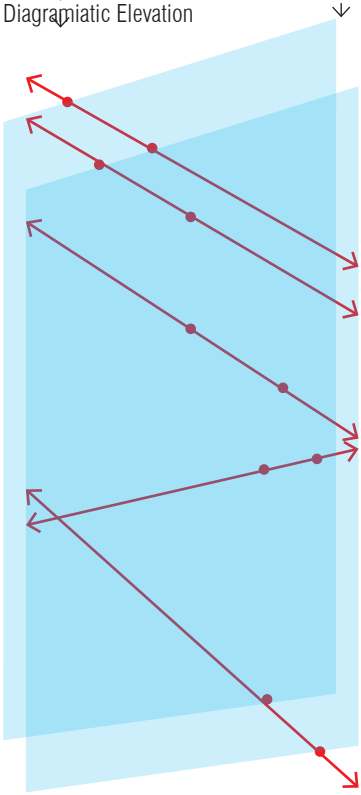
Diagramiatic Section

The insection of these planes creates directions.



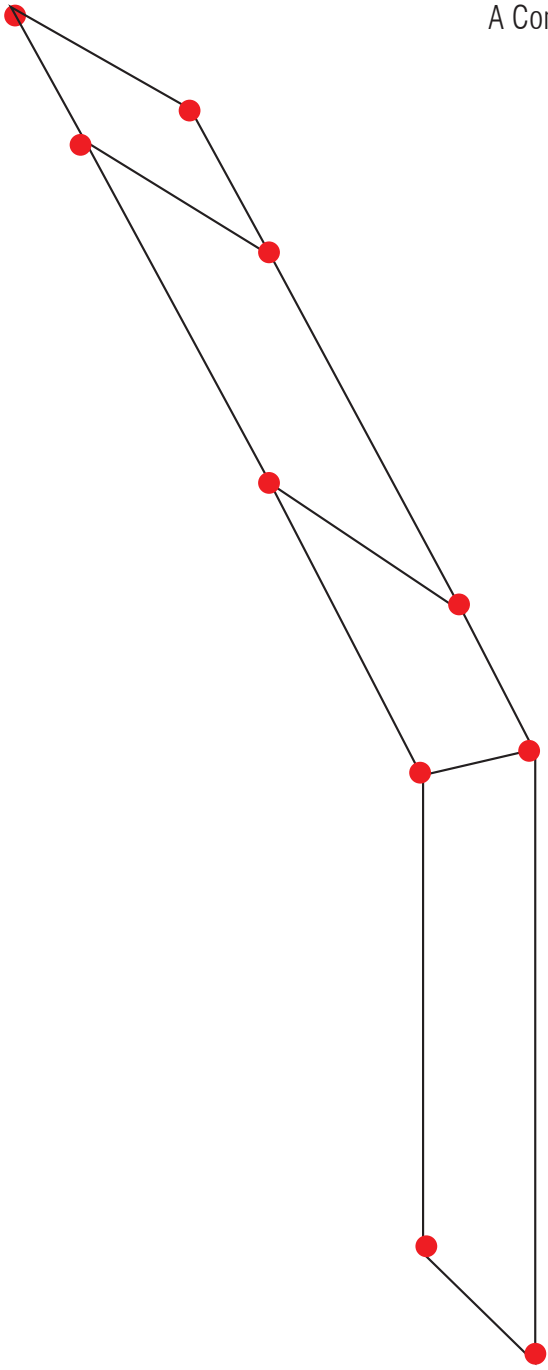
Diagramiatic Elevation

In elevation the directions are bound by another set of planes, which run vertically from the desired edge of the heliostat

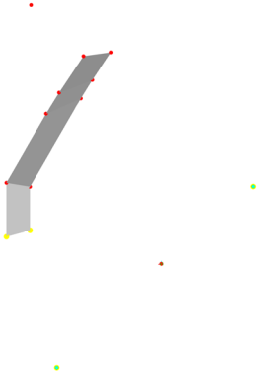


The insection of the directions and the vertical bounding planes gives a series of points from which to create polygons for fabrication.

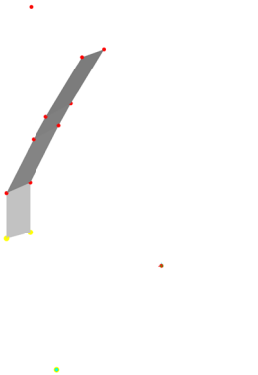
A Component is created.



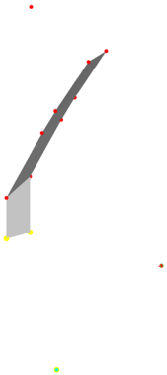
Component Study



East of North



Due North



West of North

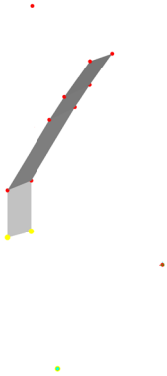
Testing the Effect of the SunPoint

Movement of the X-Axis (East-West) shows the component turning from east of north to west of north.

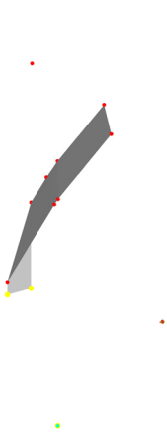
Testing the Effect of the SunPoint

Movement of the Y-Axis (North-South) shows the component rotating to scoop the light down.

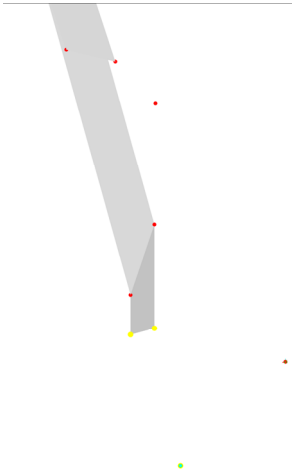
If the SunPoint is too far south the component completely turns around and tries to reflect through itself.



Due North



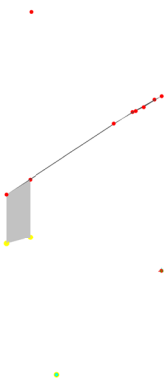
Just behind North



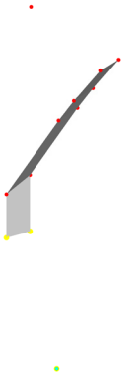
Too far South

Testing the Effect of the SunPoint

Movement of the Z-Axis shows clearly how the component reacts to angle the light down.



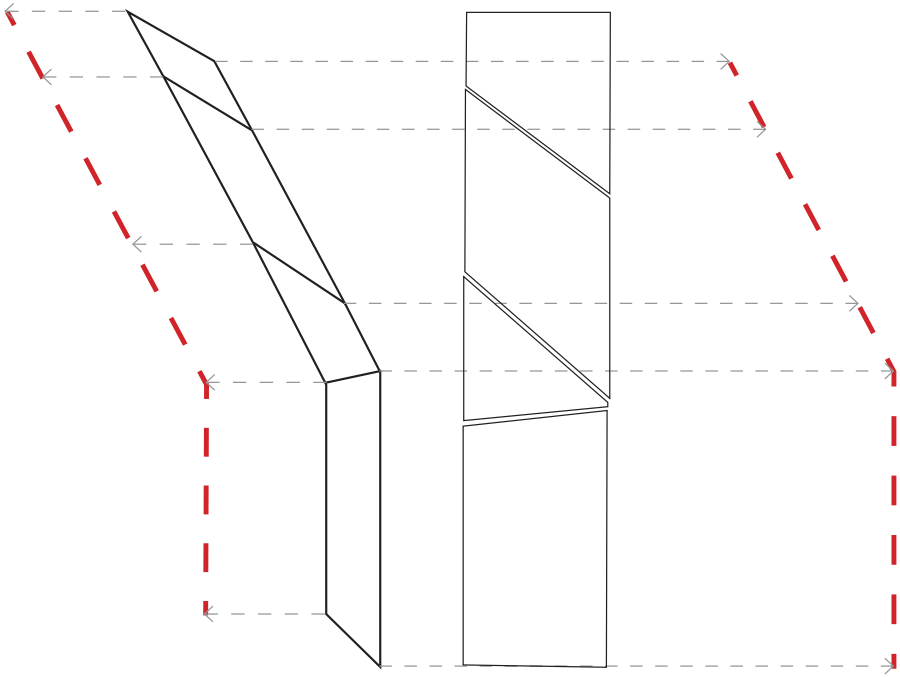
Below the TargetPoint



Typical Height

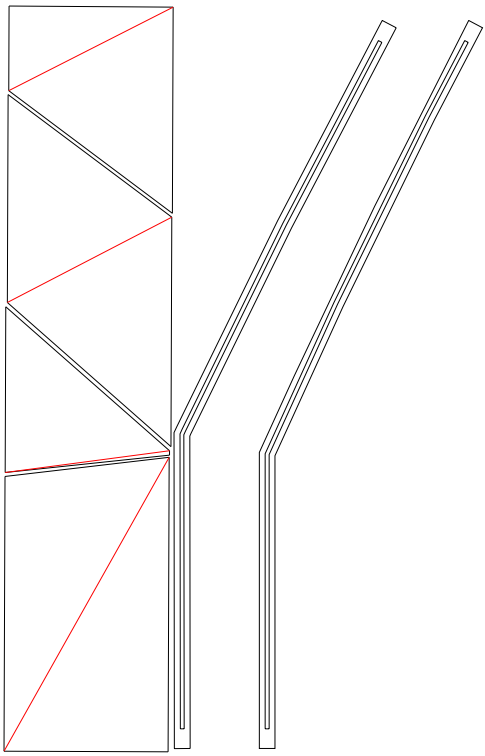
High in the Sky

Component Fabrication



From the component three critical parts are extracted for fabrication.

The polgon surfaces and the two bounding edges.



The polygon surface is unfolded as a net object for card fabrication.

The two edge profiles are offset to create side braces for the component, into which the polgon surface will slot.

Component Model

There will have 10 of these components.

This one is at 1:20.