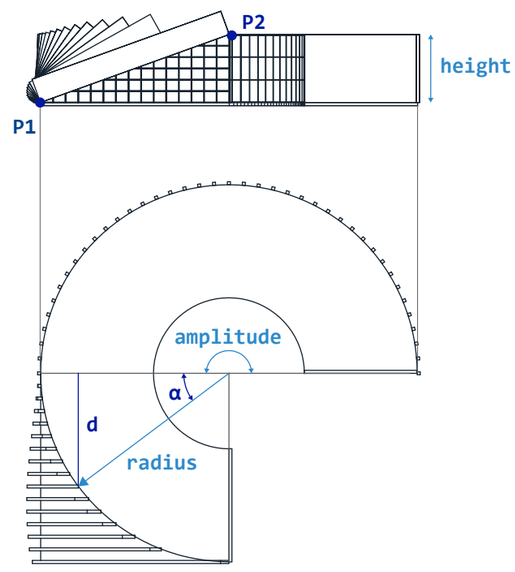
ReAD

Algorithmic Design (AD) creates designs through algorithms. AD allows flexible exploration and optimization of complex designs. However, the development of AD programs requires considerable time and expertise. **ReAD** introduces four mechanisms to help develop AD programs. Mockups are presented below, showcasing the generation of the tilted beams of the *Isenberg Innovation Hub* building (BIG Architects, 2016).

Illustration

Incorporation of images in the program, to illustrate and explain the AD program

```
beams(radius, amplitude, height, n_beams, thickness) =
  for i ∈ 1:n_beams
    let d = radius/n_beams*i
        α = arcsin(d/radius)
        P1 = perpendicular(pol(radius, amplitude), d)
        P2 = cyl(radius, amplitude+α, height)
      rectangular_prism(P1, P2, vy(d*0.1), thickness)
    end
  end

beams(25, pi, 9, 15, 0.4)
```

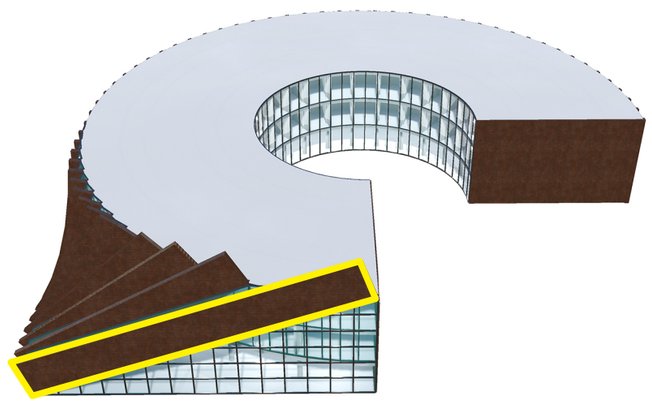


AD Tool

The AD program, on the left, illustrated on the right

Traceability

Identification of the model parts produced by selected program parts, and vice-versa, to better perceive the program-model relationship



Modeling Tool

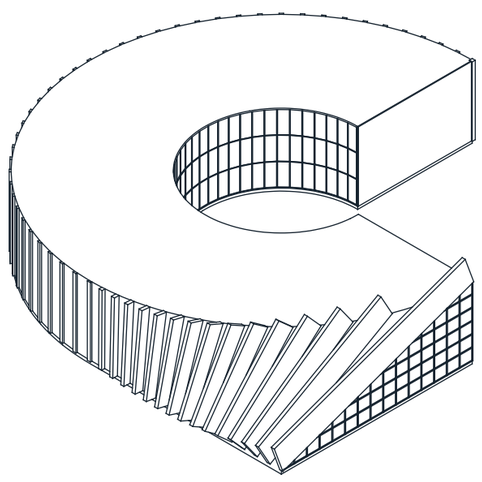
```
beams(radius, amplitude, height, n_beams, thickness) =
  for i ∈ 1:n_beams
    let d = radius/n_beams*i
        α = arcsin(d/radius)
        P1 = perpendicular(pol(radius, amplitude), d)
        P2 = cyl(radius, amplitude+α, height)
      rectangular_prism(P1, P2, vy(d*0.1), thickness)
    end
  end

beams(25, pi, 9, 15, 0.4)
```

AD Tool

Selecting a beam (on the left) highlights the corresponding program parts (on the right)

Extraction

Automatic conversion of a digital model manually produced in CAD or BIM tools into an AD program, to reduce time and errors in model-program conversion



Modeling Tool

```
line(xy(-25.0, -1.7), xyz(-24.9, -1.7, 9.0))
line(xy(-25.0, -3.3), xyz(-24.8, -3.3, 9.0))
line(xy(-25.0, -5.0), xyz(-24.5, -5.0, 9.0))
line(xy(-25.0, -6.7), xyz(-24.1, -6.7, 9.0))
line(xy(-25.0, -8.3), xyz(-23.6, -8.3, 9.0))
line(xy(-25.0, -10.0), xyz(-22.9, -10.0, 9.0))
line(xy(-25.0, -11.7), xyz(-22.1, -11.7, 9.0))
line(xy(-25.0, -13.3), xyz(-21.1, -13.3, 9.0))
line(xy(-25.0, -15.0), xyz(-20.0, -15.0, 9.0))
line(xy(-25.0, -16.7), xyz(-18.6, -16.7, 9.0))
line(xy(-25.0, -18.3), xyz(-17.0, -18.3, 9.0))
line(xy(-25.0, -20.0), xyz(-15.0, -20.0, 9.0))
...
```

AD Tool

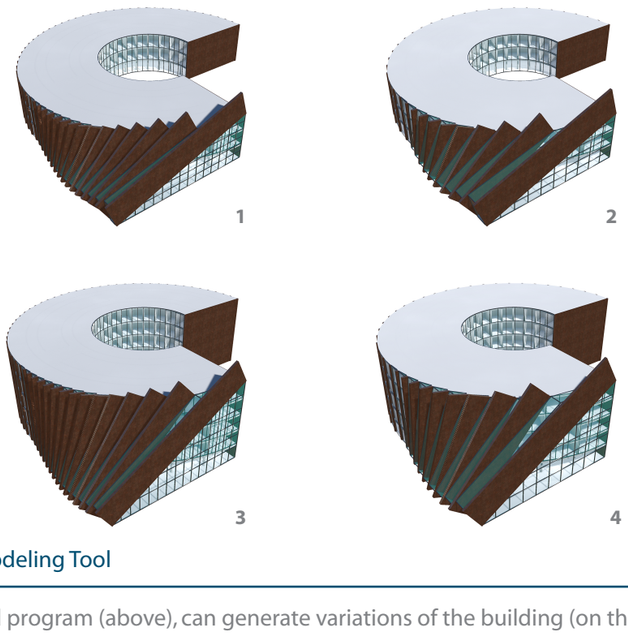
The program on the right was extracted from the model on the left

Refactoring

Semi-automatic improvement of the structure of AD programs without changing the results, to reduce time and errors in the program development process

```
beams(radius, amplitude, height, n_beams, thickness) =
  for i ∈ 1:n_beams
    let d = radius/n_beams*i
        α = arcsin(d/radius)
        P1 = perpendicular(pol(radius, amplitude), d)
        P2 = cyl(radius, amplitude+α, height)
      rectangular_prism(P1, P2, vy(d*0.1), thickness)
    end
  end

1 beams(25, pi, 9, 15, 0.4)
2 beams(25, pi, 9, 10, 0.4)
3 beams(25, pi, 15, 15, 0.4)
4 beams(25, pi, 15, 10, 0.4)
```

AD Tool



Modeling Tool

The program on the left, which is the refactoring of the extracted program (above), can generate variations of the building (on the right)

Panel for the FCT project PTDC/ART-DAQ/7870/2020