MERIDIONAL CONTOUR
Hub and shroud contours are parametric (variable).

All **PARAMETERS** can be found in the object tree on the left side in CAESES.
baseline

01_hub
- setup
  - P3_X_FACTOR
  - PLATE_LENGTH_STRAIGHT_FACTOR
  - PLATE_THICKNESS
  - R_FLOW
  - R_INNER
  - WEIGHT_2
  - X_MAX
  - Z_MAX

02_shroud
- setup
  - DIAMETER
  - P2_Z_FACTOR
  - P3_X_FACTOR
  - PLATE_THICKNESS
  - WEIGHT_2
  - Z_MAX
These parameters be changed manually, but also

FULLY AUTOMATED.
LEADING EDGE
There is a fairness optimized spline for the LEADING EDGE.

The z-positions of the start and end can be controlled as well as the two angles ...
CAMBER
There is a single **THETA FUNCTION**

where the start and end values can be controlled as well as the tangent angles of the theta function at the start and the end.

**BTW:**

Theta at start is set to zero - a global theta is applied.
From this theta function and the leading edge contour, the **CAMBER SURFACE** can be derived.
The blade surface is generated from the camber surface and **THICKNESS PARAMETERS.**
The thickness **CAN BE VARIED** from hub to shroud!
Radial control exists for thickness at leading/trailing edge, leading edge shape and the general thickness function shape for each radial location.
THICKNESS: DETAILS
Thickness function is made of an **ELLIPSE** (LE)

and a **BSPLINE CURVE** with 4 points.
**BLEND POSITION** (transition LE/Spline)

on the ellipse can be varied by using a

**SHIFT PARAMETER.**

The parameter runs in the range [0,1].

The higher the value, the larger are the blade angle.
Note: Thickness is scaled down for visualization
LE_SHIFT_HUB = 0.0

LE_SHIFT_HUB = 0.2
The **SPLINE** controls ...
TANGENT FACTOR i.e. strength.

Note that the angle is defined through blend point shift.
The **ELLIPSE FACTOR** controls whether to have a circular or ellipse-like LE.
VISUALIZE thickness information for certain radial locations...
TRAILING EDGE
TE is based on the reference model, can be ANY KIND of curve.
FINAL IMPELLER
Periodic blade is generated and \textbf{ROTATED} for the final impeller.
Each relevant patch has a **DIFFERENT COLOR** for easier automation of the meshing procedures.
If needed, a **CLOSED** and **COLORED STL** can be exported from this model.
DESIGN STUDY
The model has been tested for **ROBUSTNESS** within the current ranges of the parameters.
CAESES provides strategies for the

AUTOMATED

VARIANT CREATION.
Here is a picture of the RESULT TABLE,
and the 2D charts in CAESES ...
<table>
<thead>
<tr>
<th>DESIGN</th>
<th>ANGLE_HUB</th>
<th>ANGLE_SHROUD</th>
<th>LE_ELLIPSE_FACTOR</th>
<th>P2_FACTOR</th>
<th>P3_X_FACTOR</th>
<th>P3_Y_FACTOR</th>
<th>PLATE_LENGTH_Straight_FACTOR</th>
<th>TANGENT_END</th>
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</tbody>
</table>
Here is a picture of the

DESIGN VIEWER,

to check and compare the geometries ...