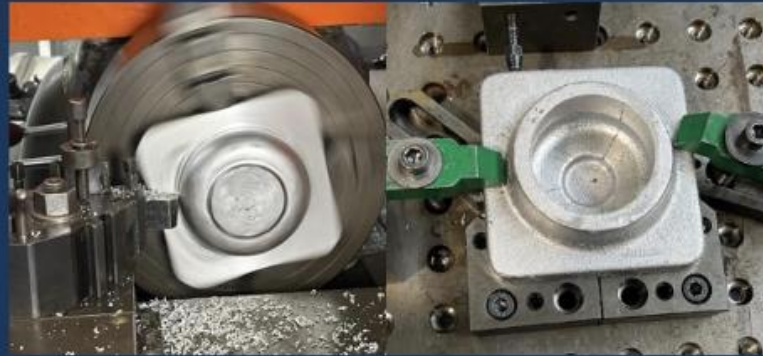# Design Portfolio

Selected Research Projects

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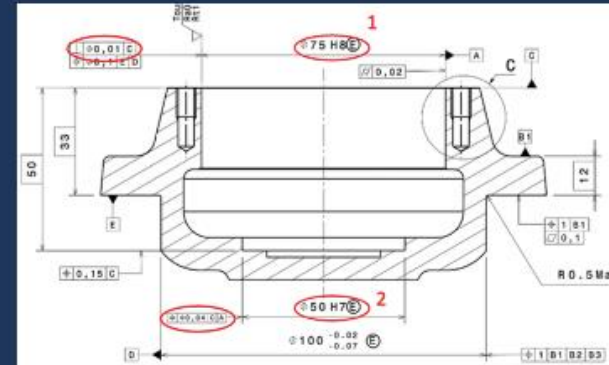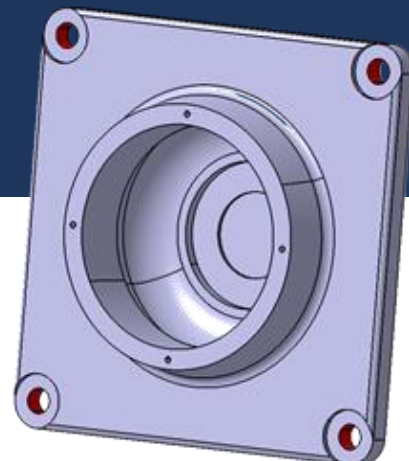Student at Arts et Métiers Institute of Technology

Objective
Full industrial development of an aluminium part, from casting design to verification geometric tolerances.

- Casted the AlSi7 alloy in a sand mold with casting allowances, draft angles, risers.

- Roughing and finishing operations with conventional lathe followed by CNC machining. Choose tools, cutting speeds, feed rates and workholding setup.

- Inspected final tolerances using a CMM: flatness, perpendicularity, location. Filled the GPS tolerancing sheet.

Optimization of drilling an aluminum block

Research Project

Curry spirals to
study castability

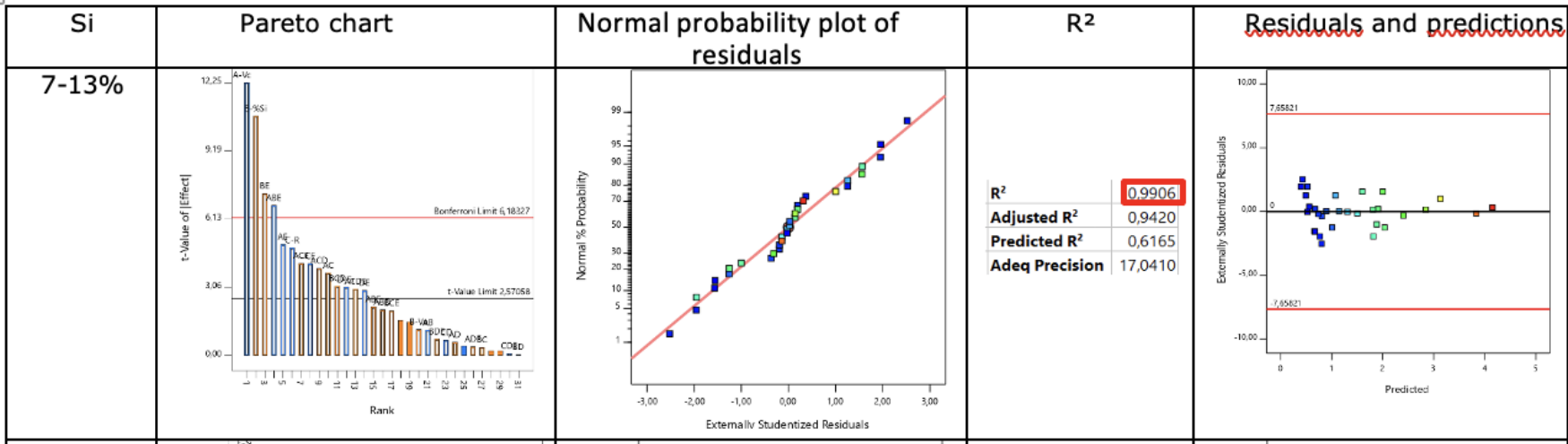Drilling of 36 holes with varying
Cutting speed and feed rate

Measurement of the sample's hardness
using a microhardness tester

Objective
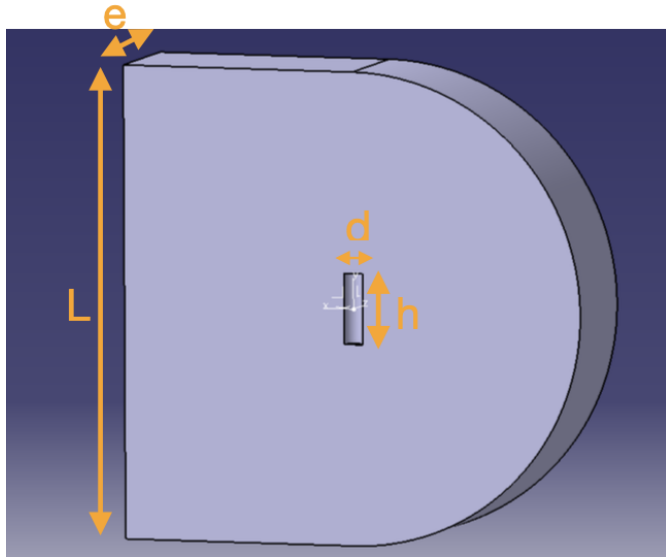Optimisation de facteurs pour le perçage d'une pièce en aluminium.

- Casting of aluminum blocks with different silicon contents Higher silicon content improved castability according to Curry spiral tests.

- Drilling of 36 holes using various cutting speeds (Vc) and feed rates (f) based on tool manufacturer recommendations.

- Measurement of hole hardness using a microhardness tester

- Analysis of the influence of different factors on the root mean square of the local slope (Rdq) using Design Expert

- Conclusion : cutting speed (Vc) and silicon content significantly affect Rdq.

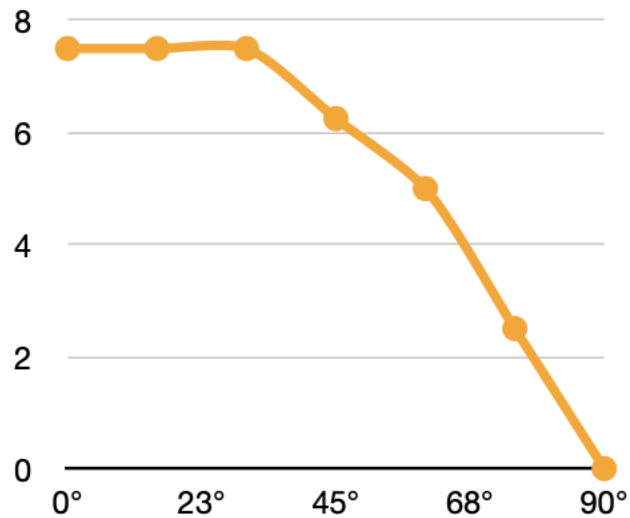| Si	Pareto chart	Normal probability plot of residuals	R²	Residuals and predictions
7-13%			R² 0,9906 / Adjusted R² 0,9420 / Predicted R² 0,6165 / Adeq Precision 17,0410	

Output from Design Expert software to evaluate
the influence of factors on surface quality (Rdq)

Cylinder in a flowing fluid

Research Project
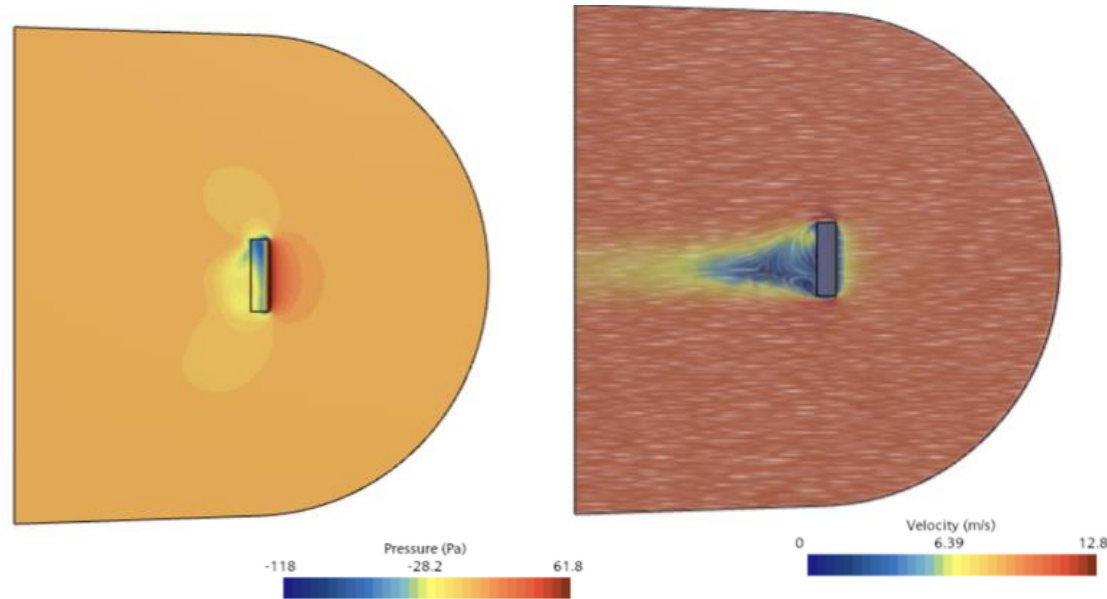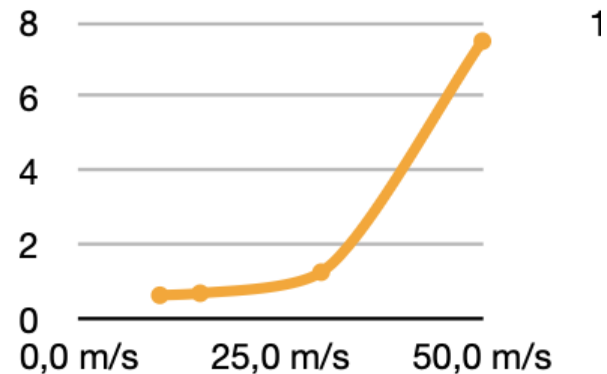

CAD on Catia V5

Pressure (Pa)
-118   -28.2   61.8

Velocity (m/s)
0   6.39   12.8

Velocity field for a 0° angle of attack

Cx as a function of the angle of attack
$50 \ ms^{-1}$

Cz as a fonction of velocity
60°

Arts Institute of Technology **et Métiers**

Objective

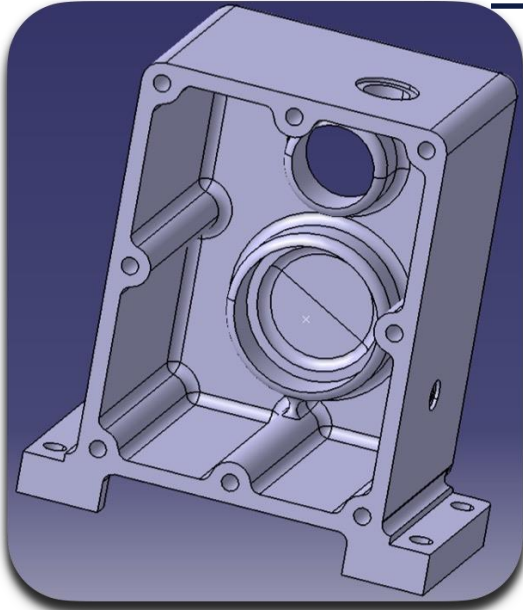Analyze the fluid flow around a cylinder using STAR-CCM+.

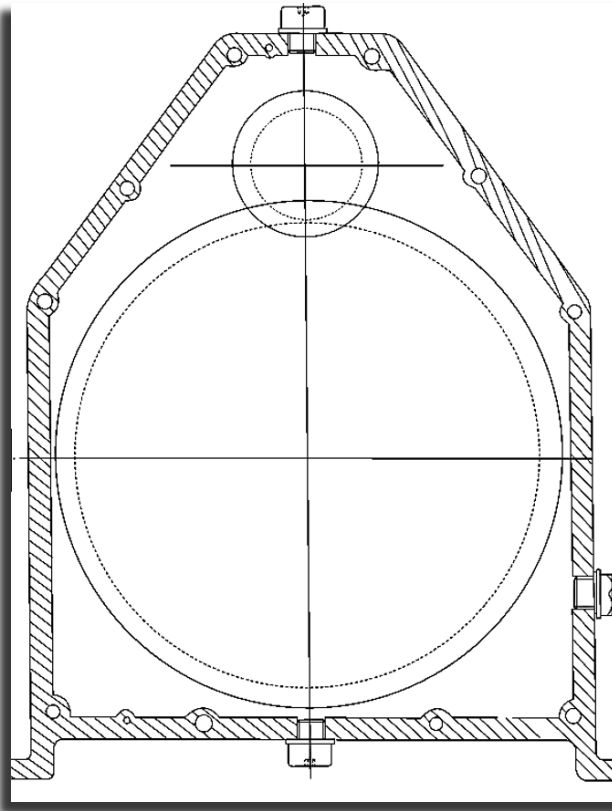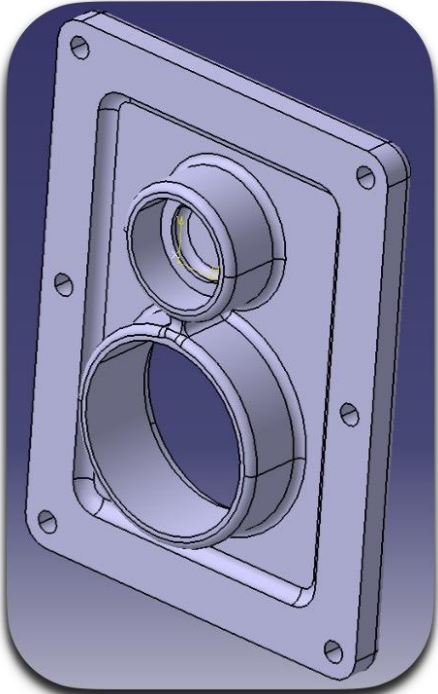- Modelled the cylinder in Catia V5.

STAR CCM +

- Divided geometry into a control surface with steady-state flow and constant density assumptions

- Studied included fluid velocity, angle of attack, and fluid density.

- Visualized the pressure and velocity field, tthe lift coefficient (Cz) and drag coefficient (Cx).

- Concluded Cx depends on the effective surface geometry and increases with fluid density. Cz increases significantly with fluid velocity.
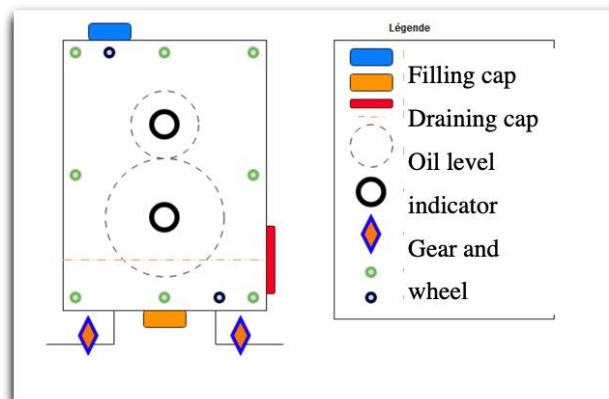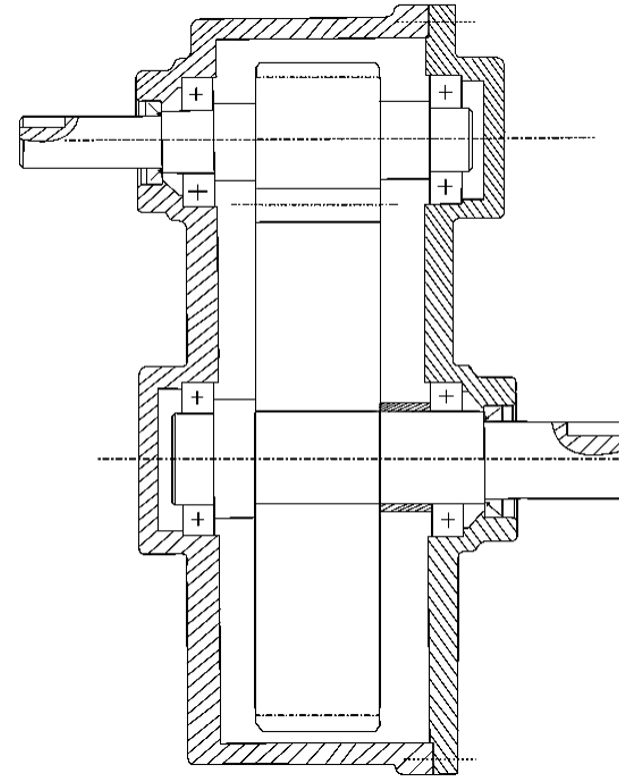
Industrial Power Reducer Design

Research Project

CAD of the reducer

Detailed plan of the reducer

Légende

- Filling cap
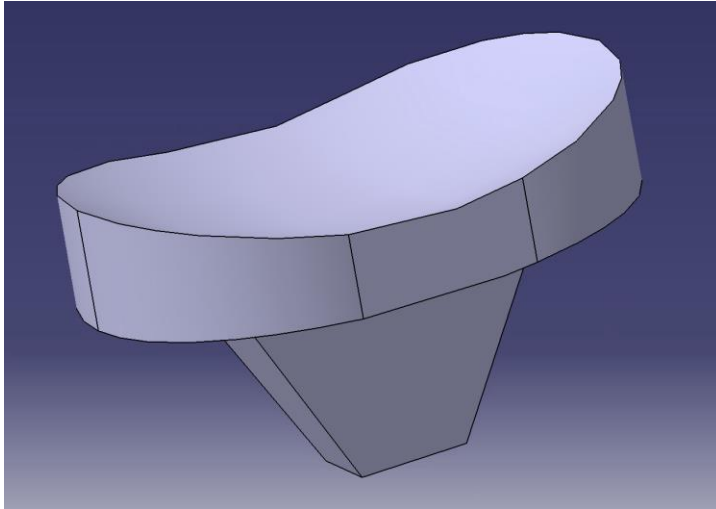- Draining cap
- Oil level indicator
- Gear and wheel

Objective

Design and develop a mechanical reducer, including its architecture, components, and assembly.

- Developed kinematic and technological schemes for the reducer design.

- Sized study for shaft and gear diameters and designed the casing, cover, and shaft structure.

- Selected appropriate bearings, keys, and joints for optimal functionality.

- Conducted a study to determine the appropriate lubrication system for efficient operation.

- Created detailed assembly drawings and CAD models for the complete reducer.

Shoulder implant design
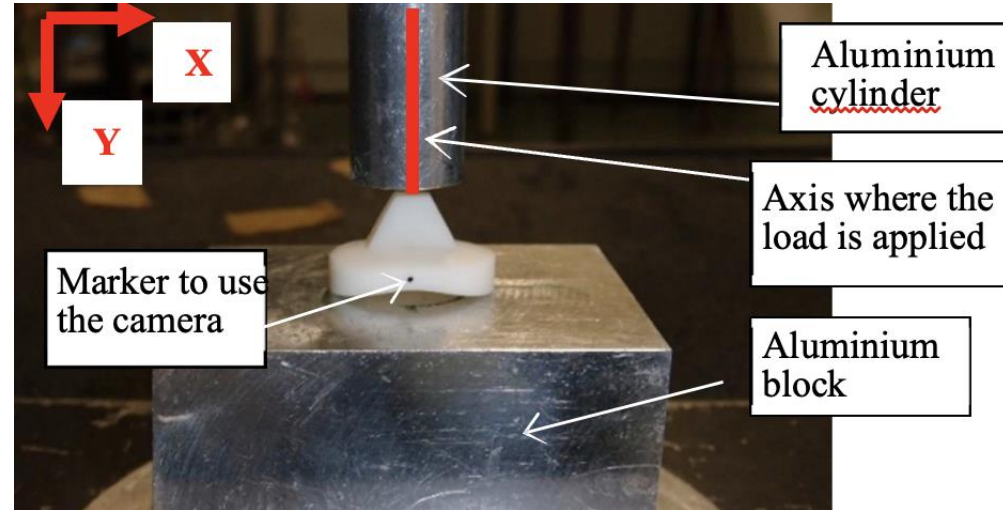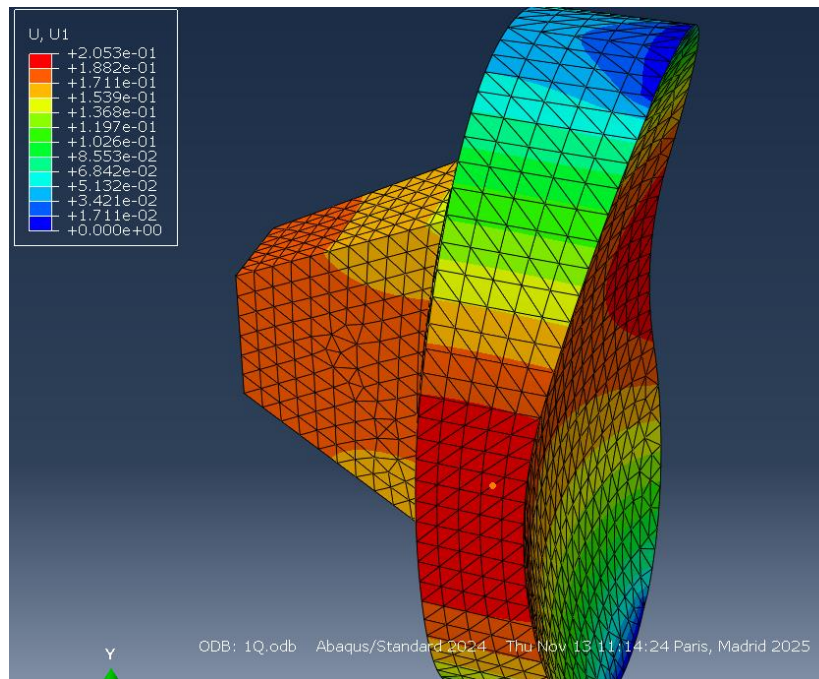
Biomécanique project

CAD on Catia V5

X

Y

Aluminium cylinder

Axis where the load is applied

Marker to use the camera

Aluminium block

Diagram of the compression test

U, U1
+2.053e-01
+1.882e-01
+1.711e-01
+1.539e-01
+1.368e-01
+1.197e-01
+1.026e-01
+8.553e-02
+6.842e-02
+5.132e-02
+3.421e-02
+1.711e-02
+0.000e+00

Abaqus simulation

ODB: 1Q.odb   Abaqus/Standard 2024   Thu Nov 13 11:14:24 Paris, Madrid 2025

Objective

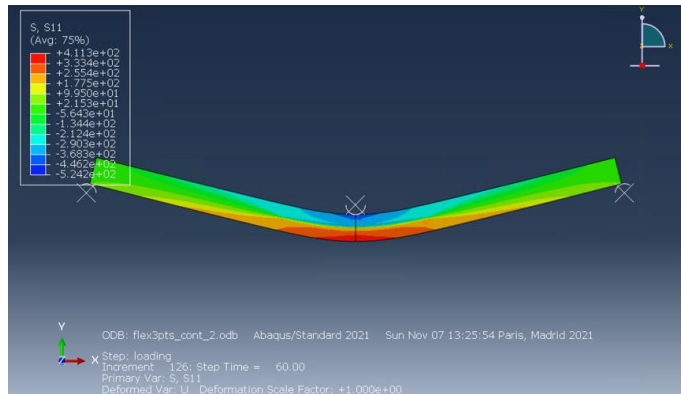Design and Testing of the Glenoid Component of a Shoulder Prosthesis.

- Designed the glenoid component of a shoulder prosthesis using Catia V5.

- Manufactured the component with a polyethylene 3D printer.

- Performed a compression test using a high-precision camera to measure marker displacement and determine the mechanical properties (E, v).

- Simulated the compression test in Abaqus to obtain a validated mechanical model and conduct finite element analyses.

Plasticity tests: three-point bending and frame structure

Research Project

Three-point bending test using hydraulic press
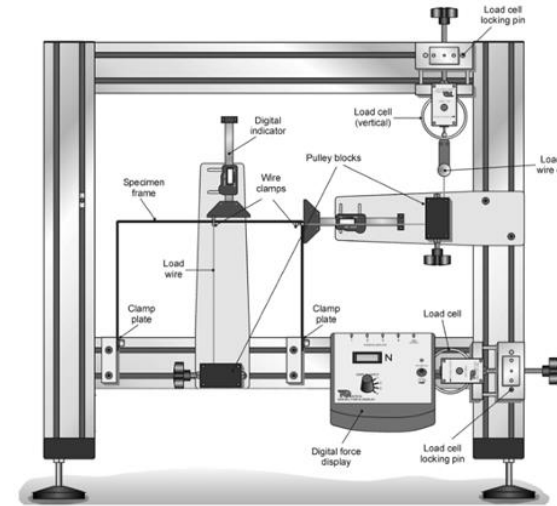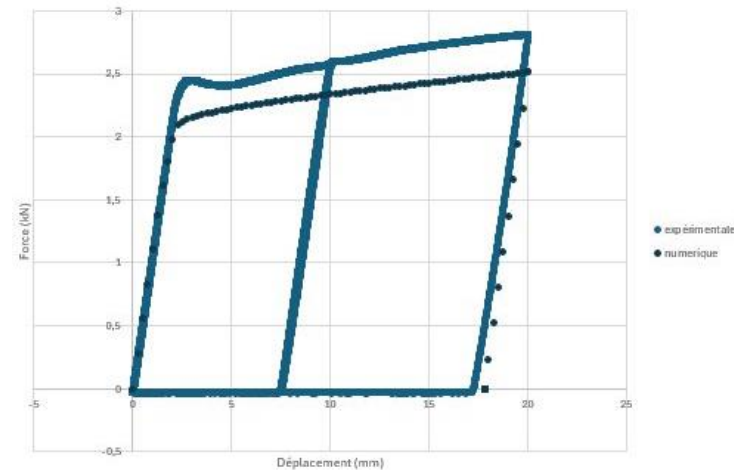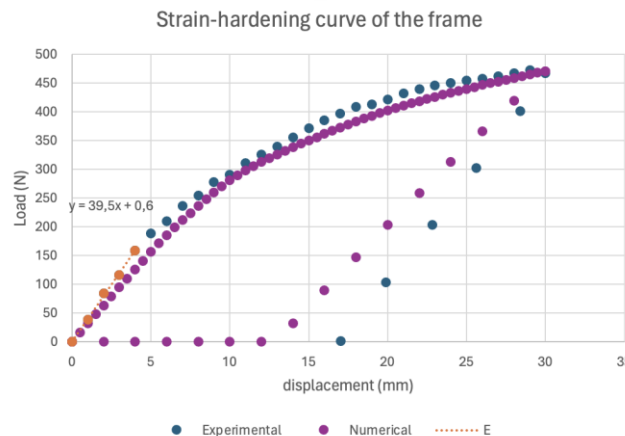

CAD three-point bending

Diagram of the frame test

Strain-hardening curve of the frame

y = 39,5x + 0,6

Strain-hardening curves obtained by varying elastic modulus, strain hardening coefficient, yield strength

Objective
Plasticity tests on a three-point bending beam and a frame structure with theoretical, experimental, and numerical analysis

- Experimental: applied sufficient to induce plastic deformation displacement was measured using sensors to obtain strain-hardening curve.

- Theoretical: determined plastic moment and ultimate load using the virtual power principle, failure mechanisms and Varignon's relation

- Numerical: used a Python script to compute the deformed shape in Abaqus. Identified Plastic hinges and iterated material parameters (E, n, $Rp_{0,2}$ (to match the experimental and the numerical curve in Excel.