European Project Semester

PROJECT OUTLINE

Project dates: Sept 2024 – Jan 2025

Title: Design to cost approach for metal parts of a small hydraulic turbine

Project activity areas: Mechanical design, Mechanical validation

Keywords: Design to Cost approach, hydraulic turbines, mechanical design, power transmission, metalwork

Tutor's name and coordinates

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Project origin

Association VISETA
SIRET N°87921731300011

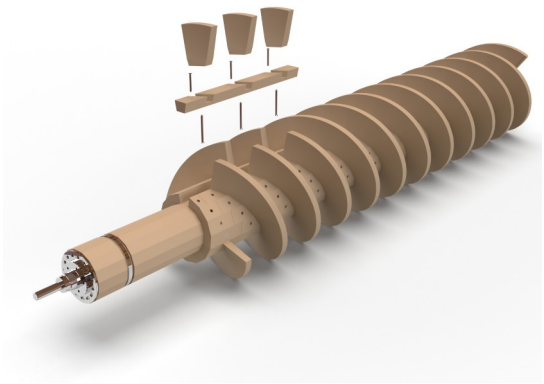
Project technical background:

The VISETA project aims at developing a small hydraulic turbine (3kW hydraulic power rating) for old mill refurbishment with minimum environmental impact (fishes, climate change, etc). Main objectives of the technology are to be replicable and affordable in many countries.

To that end, a wooden made screw turbine– easy to manufacture and easy to install – has been designed. A ½ scale proof-of-concept is currently being tested in an old mill.

This study focuses on the power transmission perimeter: Mainly composed of metallic parts (bearing, rim, shaft, pulley), objective is to decrease cost by applying a "design to cost" approach for selecting the best solution. Off-the-shelf components (automotive, agriculture) will be good candidates for most of sub-parts, since they are cheap and easy to find.

A mechanical study will have to be done to validate the solution (lifetime, corrosion).

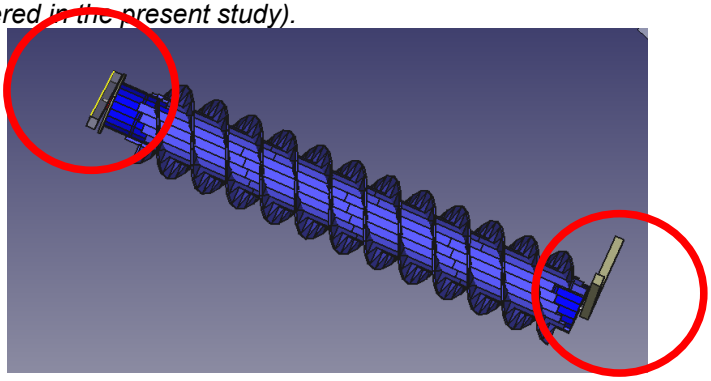


Studied topics:

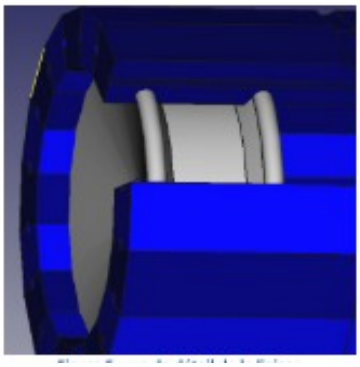
- Analysis of requirements and technical specifications for power transmission
- Design of mechanical solution (one or two alternatives)
- Research for "off-the-shelf" components
- Applying a design-to-cost methodology for selecting the solution
- Mechanical validation of the solution
- Manufacturing drawings of the to-be-manufactured parts

Study Details:

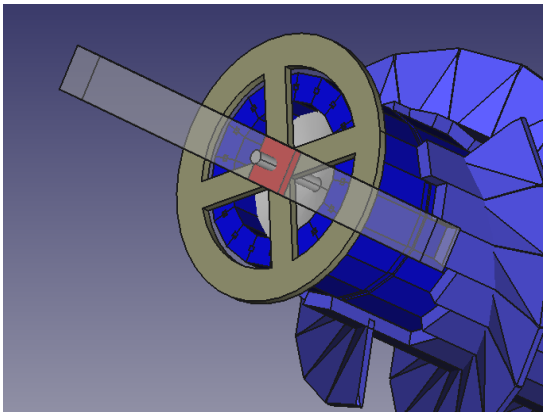
- The power screw is mounted on bearings at both ends: The top bearing is a ball-bearing (out of water) receiving axially tensile force and lateral force. The bottom bearing is a non-lubricated bearing receiving only lateral forces. (*Note: This bottom bearing is currently being designed in another study and will not be considered in the present study).*



- The turbine central shaft is made of trapezoidal wood slats which are bounded with steel strapping on 2 metallic parts at both ends (see figure 2). These two parts are called “top rim” and “bottom rim”. Current hypothesis is to use 13” car rims for these 2 parts. These two rims are connected to their shaft. This shaft goes then in its corresponding bearing. The bottom rim and its corresponding shaft are underwater.



- For power transmission to the power generator, a leading sprocket or pulley (both solution shall be studied), is screwed to the wooded made shaft and shall transfer the turbine power to the electrical generator.



The study shall consider the following perimeter

- **Turbine Top end:** Bearing, leading Pulley (or sprocket), metal shaft, connection to the rim, rim
- **Turbine Bottom end:** metal shaft, connection to the rim, rim

The study shall

- search for mechanical solutions, look for corresponding off-the-shelf components, and apply a design-to-cost approach for selecting the best solution.
- Validate the mechanical behavior of the system in its environment (water, lifetime, ...)
- provide the drawing of the specific parts to be machined.