Project: Technological own consumption decrease of Hydro electrical power plants by using micro hydro electrical power plants which uses the water kinetic energy inside hydro electric site. Acronym HIDRO4LESS

Ctr. 62/2014 Financed by State Budget - Contracted Authority Unit Executive for Funding Education Higher, Research Development and Innovation (UEFISCDI), Partner in Priorities Fields, Period 2014-2016

Coordinator: Electra Total Consulting SA, **Partner:** STRAERO SA

In this project is developed decrease of the technological own consumption of Hydro electrical power plants by design of hydraulic axial turbine propeller with variable leap which can use the water kinetic energy inside hydro electric site. This kind of turbines are called "VHL - Very Low Head" and there were developed for hydro electric sites with 1.4 - 5 m piezometric heights and 10-30m^3/s debits.

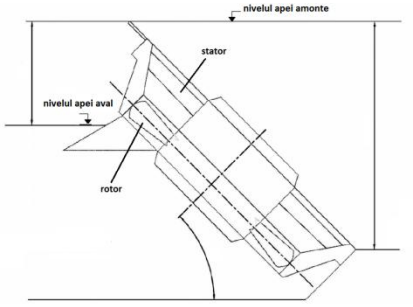

Fig.1 Scheme of an VLH turbine instalation

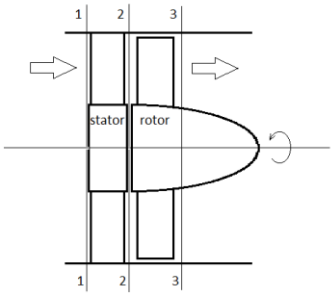

Fig. 2 Principal sections through turbine

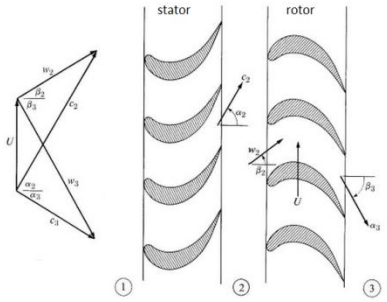

Fig. 3 Plane net of the turbine stages and the velocity triangles

Stator and rotor blades profiling is developed by preliminary design through a calculus on the average radius of the stage. On first approximation will omit the number of the blades and its profile and the loses of the turbine, by choosing a reasonable number of blades and a classic profile.

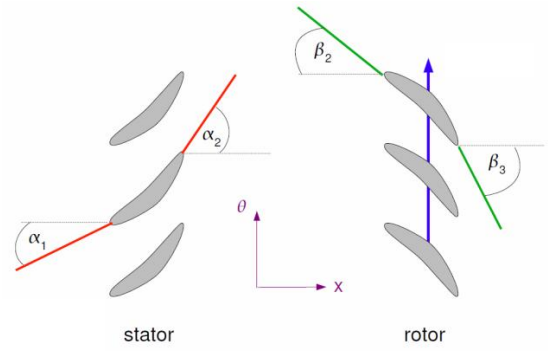

Fig. 4 The angles that must be determined

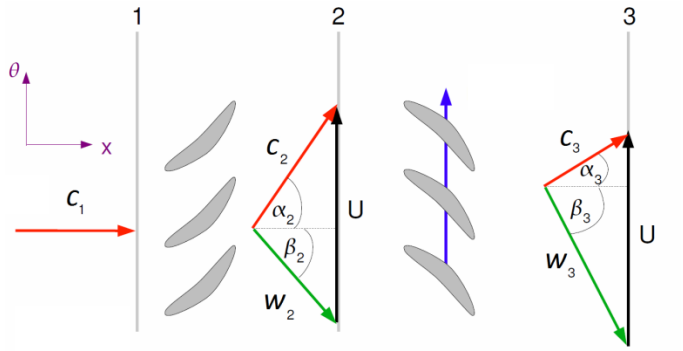

Fig. 5 The velocity triangles for the VLH turbine

The design of the stator and rotor blade profiles is a complex issue which is resolved through mix methods (theoretic, numerical and experimental). In this stage of the project were used theoretic and numerical methods for its developing. Was chosen a base profile for low velocity, the width of the net

was established (0.45m for the stator and 0.60m for rotor) and the number of the blades (18 for stator and 8 for rotor) and using the obtained angles from de calculus in the longitudinal radius and that leaded to the following profiles showed in fig. 6 and 7.

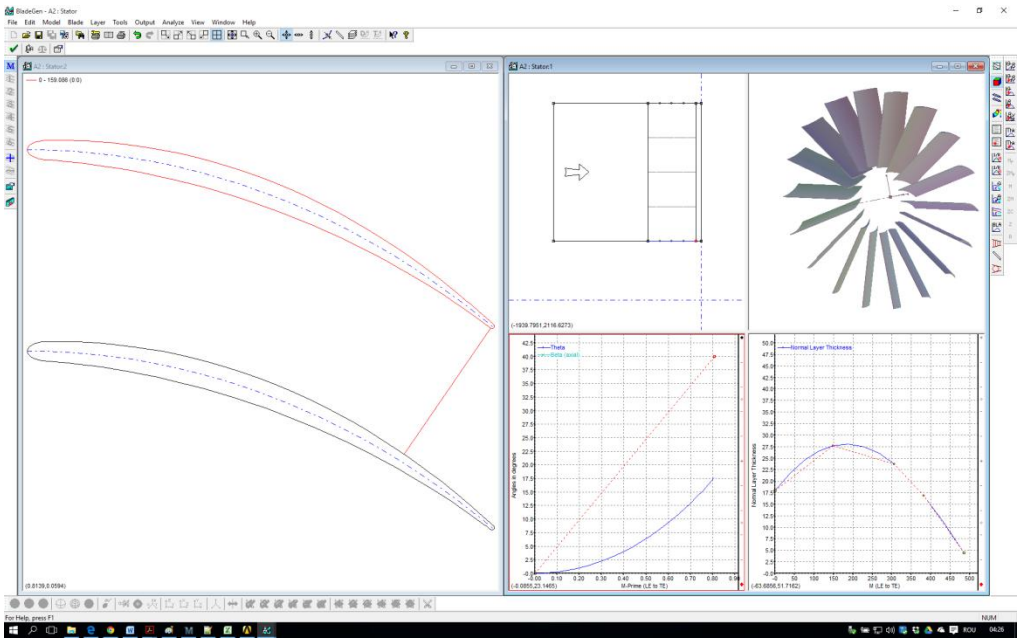

Fig. 6 Stator profile of the blade

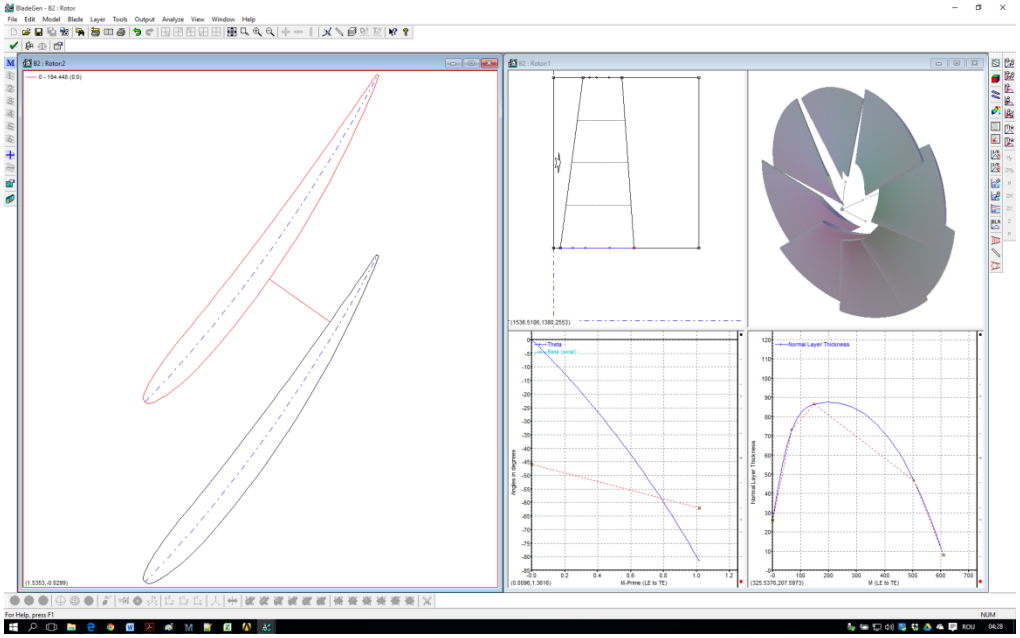

Fig. 7 Rotor profile of the blade

For this configuration of design will be performed an numerical analysis of the flow inside the turbine through numerical analysis of the stator and the rotor.

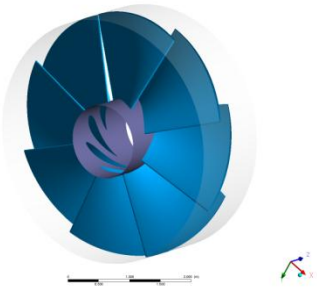

Fig. 8 3D isometric view of the blade

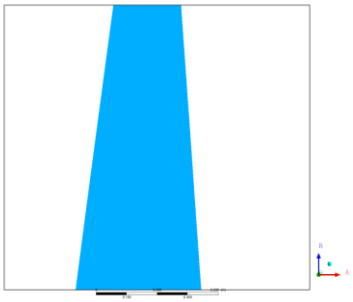

Fig. 9 Meridional view of the blade

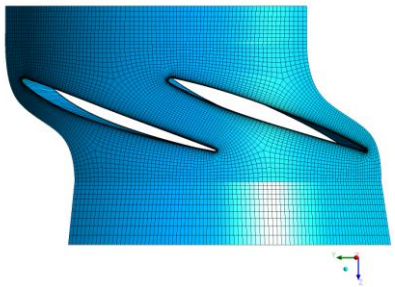

Fig. 10 Finite elements of the blade

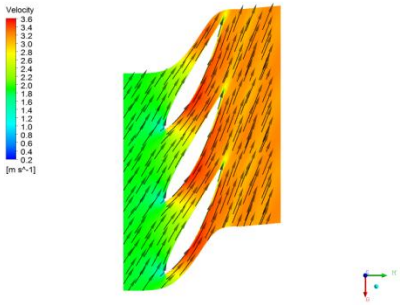

Fig. 11 Velocity vectors at 20% from the span

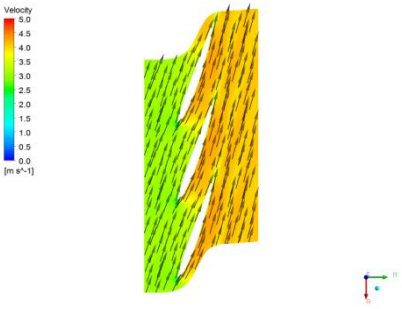

Fig. 12 Velocity vectors at 50% from the span

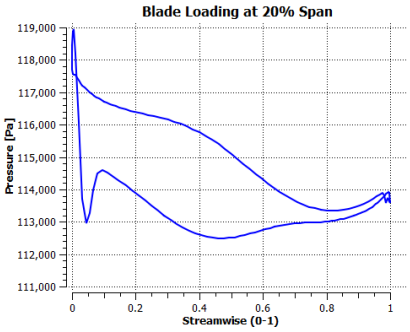

Fig. 13 Graphs with the loads on the blade at at 20% from the span

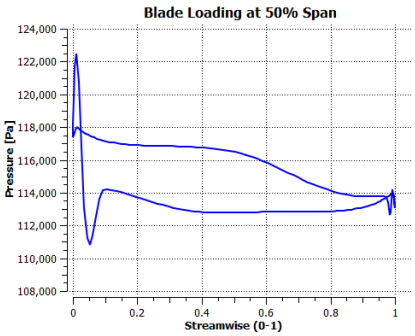

Fig. 14 Graphs with the loads on the blade at at 50% from the span

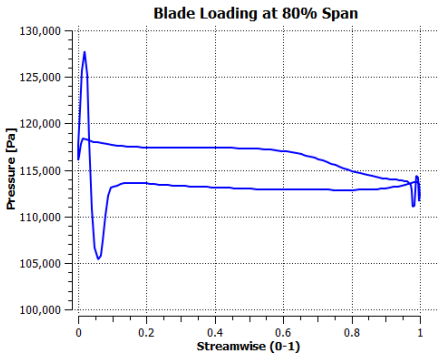

Fig. 15 Graphs with the loads on the blade at at 80% from the span