STRUCTURAL SIMULATION

Case description: The purpose of this Benchmark is to find the service limits of an aluminum rotor and set the dimensional tolerances that must be established to don´t interfere with the other components during operation.

Fig. 1 – Rotor´s geometry

Development: We proceeded to make the mesh of the finite element model, it can be seen in Fig. 2.

Fig. 2 – FEM Mesh

Considering the properties of the material, boundary conditions and a rotor speed of 5000 rpm were applied gradually to find the limit to which the rotor fails. The failure criterion was set at 160 MPa (Von Mises). The results were:

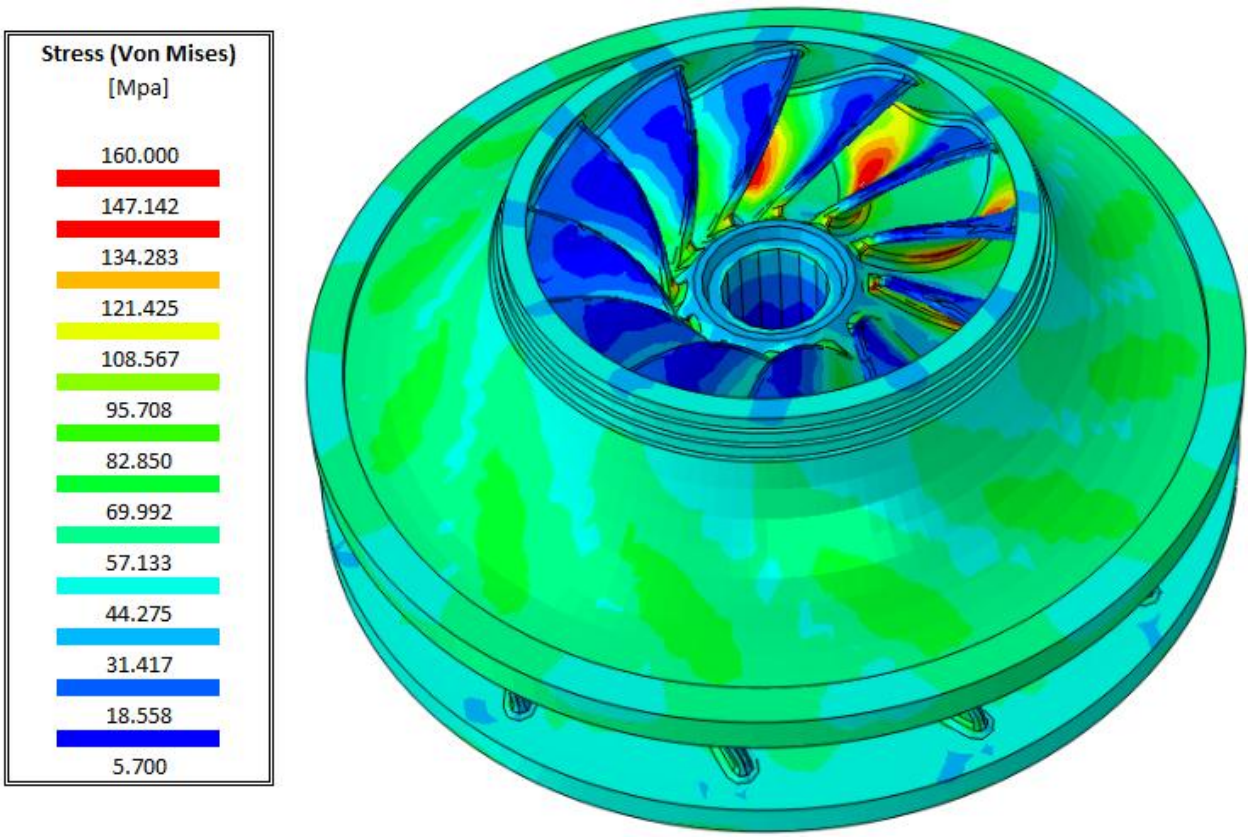

Fig. 3 – Stress limit reached @ 2864 rpm

Service limit with the criterion adopted was reached at 2864 rpm. In turn, the maximum radial expansion experienced by the rotor due to the acting inertial forces was 0.515 mm, as shown in Fig. 4.

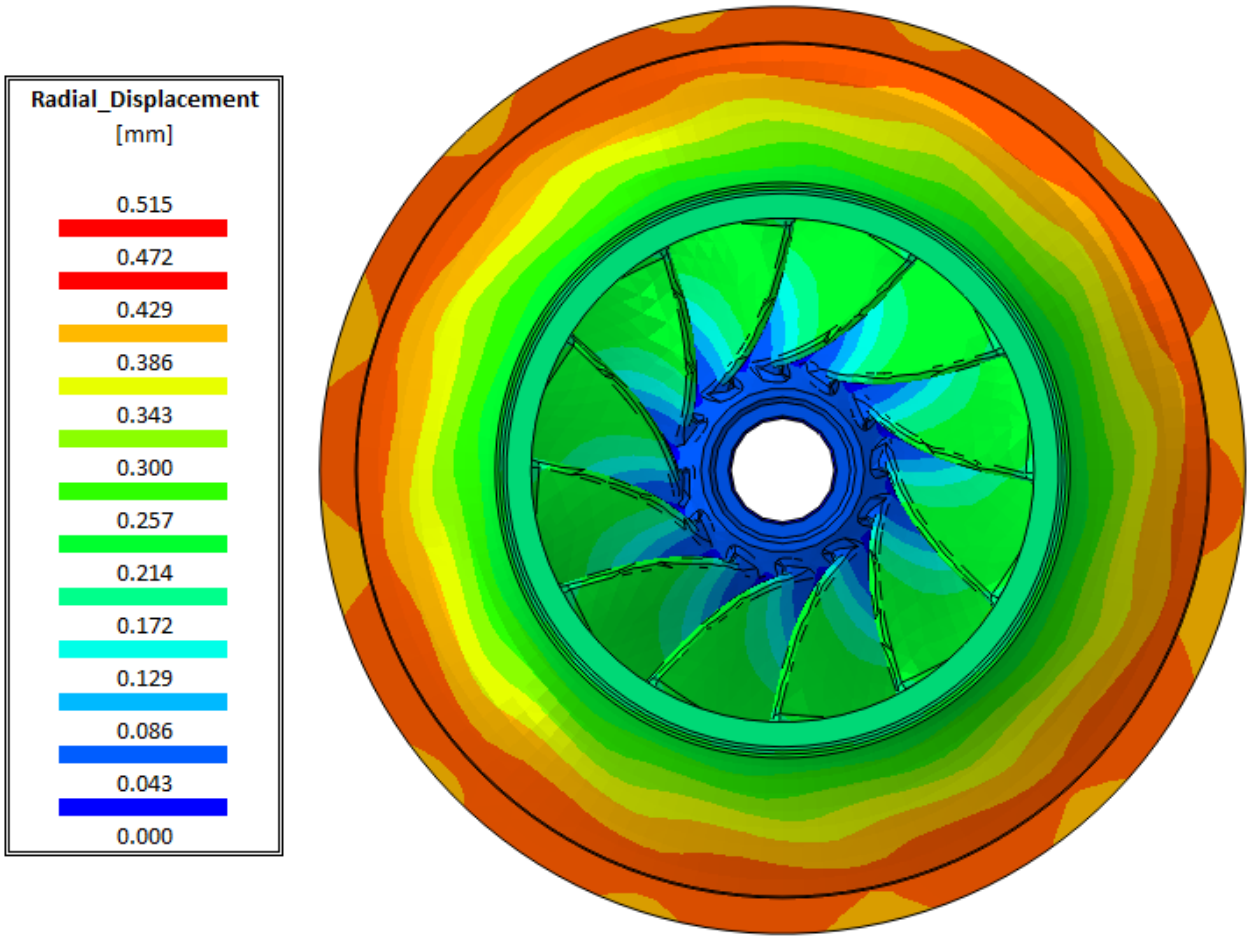

Fig. 4 – Radial displacement of the rotor (expansion)

From this result arise the distances and manufacturing tolerances that must be considered between the rotor and the remaining assembly components.

To increase more the rotor service speed several steps can be carried out for this purpose; in this particular case wasn´t necessary but a more efficient mass distribution could be an alternative to consider.

Conclusions: Through the numerical simulation it was possible to know in advance the speed limit at which the designed rotor is able to rotate without fail. Another useful result is known which will be the expansion of it in each of their diameters to establish an assembly without interference problems once in operation.

Note that in the case of need can be also simulated thermal expansion it may suffer in the case of working at temperatures above the rotor manufacturing temperature.

Due to the complexity of the geometry discussed, precise analytical estimates of stresses and strains would have been very difficult (if not impossible) to obtain. The finite element method allowed to know these values in the virtual design stage without the need to manufacture the part, test it and correct the mistakes, avoiding costs and time involved in those activities.