Optimization of the shape and mechanical properties of a piston in a passenger car internal combustion engine

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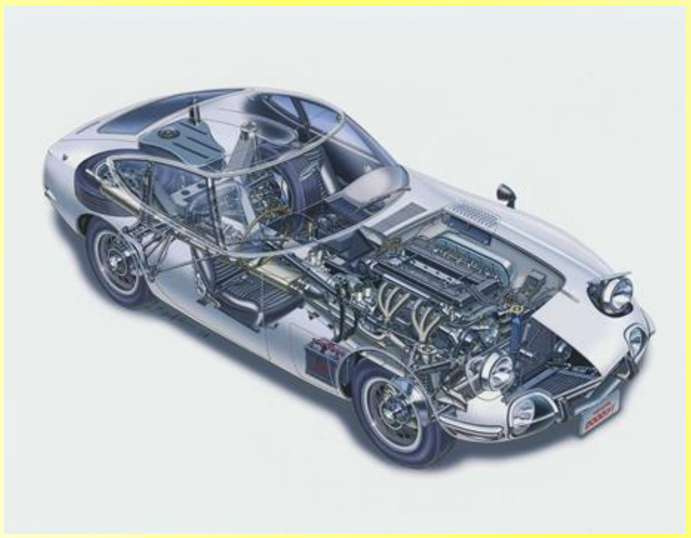
Introduction

The extraordinary value of the present invention includes both the production technology and the contribution to the development process of automotive.

A large increase in interest in computer simulation has been seen in the recent decade. The scientific and technical community has realised that this tool can be used for solving many scientific and engineering issues emerging in modern technology. Computer simulation was created by way of cooperation between mathematical, natural, technical and computational sciences. Computer simulation is an alternative for experimental and observational techniques, where phenomena cannot be observed and identified very often.

The aim of this was to perform computer simulation of stresses and displacements of different piston construction of a passenger car engine under the influence of a given pressure.



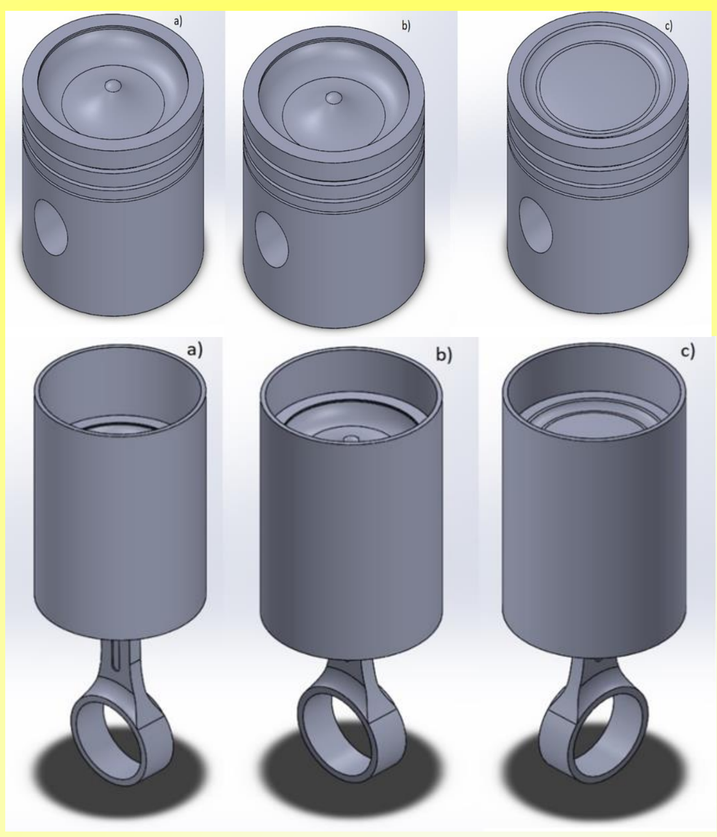
As a part of work, three models of pistons with different pistons head were compared:

- Piston with deep bowl.
- Piston with deep bowl and cooling galleries.
- Piston with flat bowl.

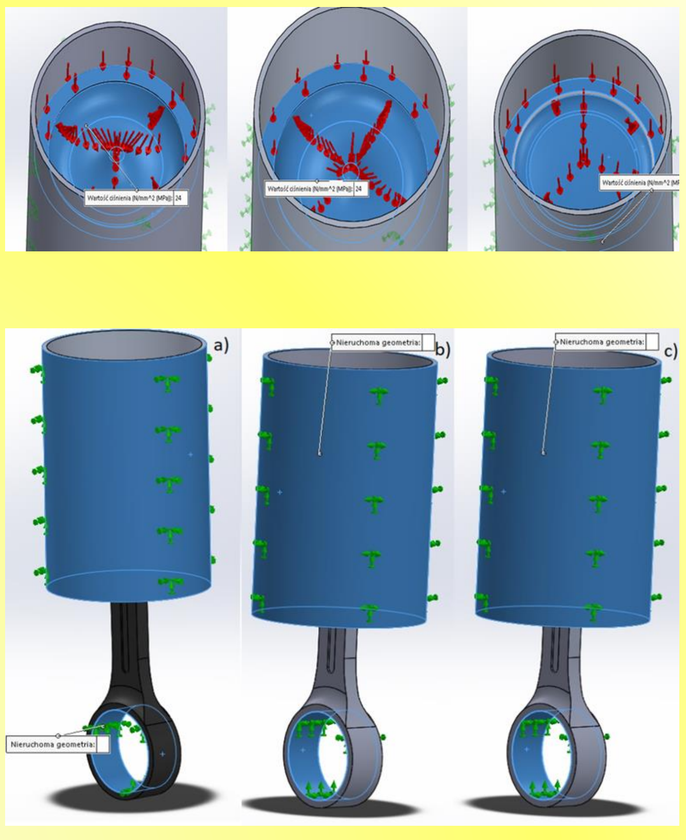
In addition, for the simulation made models of pin, connecting rod and the surface corresponding to the cylinder block.

A numerical analysis of stresses and displacement was performed using the finite element method in the SolidWorks program and performed comparative analysis of them.

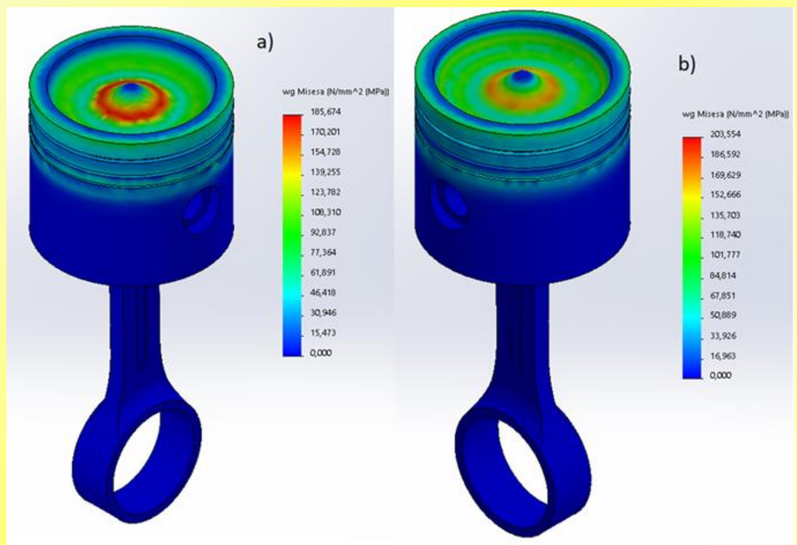
Results

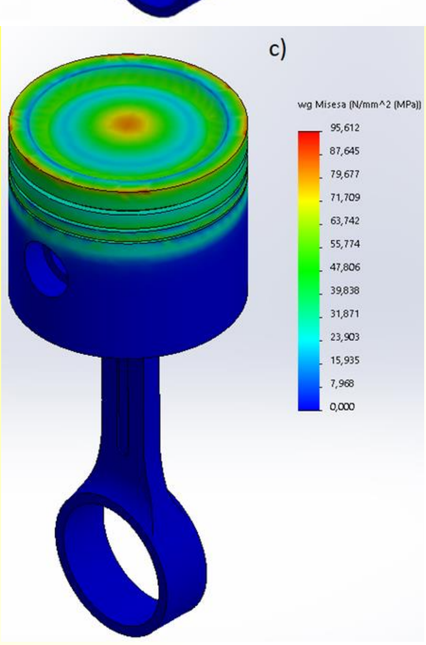


Isometric view of assemblies for the following pistons: a) deep bowl, b) deep bowl with cooling galleries, c) flat bowl



View of place where external load was applied. a) model with deep bowl, b) model with deep bowl with cooling galleries, c) model with flat bowl





Isometric view of the stress distributions a) model with deep bowl, b) model with deep bowl with cooling galleries, c) model with flat bowl

Conclusion

- The lowest stress value recorded for a piston with flat bowl. However focusing on efficiency aspect it is worth to underline that in the case of an internal combustion engine, that has got good efficiency and there is not need to create additional cooling systems, the best solution would be a piston with deep bowl without cooling channels.

- Numerical analysis showed that difference between displacement values for all of three pistons are small and could considered insignificant in the context of their operation. It is worth to mention marginal effect of adding cooling channels on the increase in their values. Comparing pistons with deep and flat bowl, displacement values depends only on thickness of piston head.