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Design, Optimization and Development of Assemblies for Continuous Casting Facility using Techniques CAD, CAM and CAE

This work presents design methods, optimization and realization of mechanical for continuous casting plants using modern techniques: CAD, CAM and CAE. These current techniques refer to techniques CAD (Computer-Aided Design), CAE (Computer-Aided Engineering) and CAM (Computer-Aided Manufacturing). Techniques mentioned above are areas of information technology aimed at helping engineering a variety of areas to be faster, more efficient and creative. A synthesis of the works published in the last 15 years shows that computer aided design and manufacturing are two areas which have developed simultaneously being treated in a common vision based on the natural links that exist between the activities of design and production or manufacturing. The paper will present a practical case application of techniques CAD, CAE and CAM.

Keywords: CAD, CAE, CAM, simulation, finite element

1. Introduction

The literature CAD / CAM is an acronym, which means: computer aided design and manufacturing.

This innovative technology that uses digital computers for carrying out various functions of design and production tends total integration of these activities, activities that in a traditionally way were considered as being as separate and distinct activities.

Overall, the technique CAD / CAM / CAE develops advanced technology of the future enterprise, fully aided by computer, from idea to finished product. Computer Aided Design (CAD) could be define as an activity of using of a product [1]. Equipment and computer programs are forming the system, which provides the functions required in design. A computer, one or more graphic terminals and other

peripherals as input or output devices (printers, plotters, acquisition systems, etc) form CAD. CAD programs are graphical applications for implementation in a computer system, plus specialized software engineering functions.

They can achieve a state of stress and deformation analysis of some elements, dynamic analysis of mechanisms, calculation of heat transfer and numerical control. Specialized programs, complementing the graphics varies from one user to another, depending on the type of production lines, manufacturing process and specific markets [2].

Computer Aided Manufacturing or CAM manufacturing is define as using a computer system in the planning, management and control operations of a manufacturing process using any direct or indirect interface between computers and production resources.

2. Making a straight bevel gear using CAD, CAE and CAM techniques

It was proposed to make a straight bevel gear as a pinion for rack gearing (see figure 1).

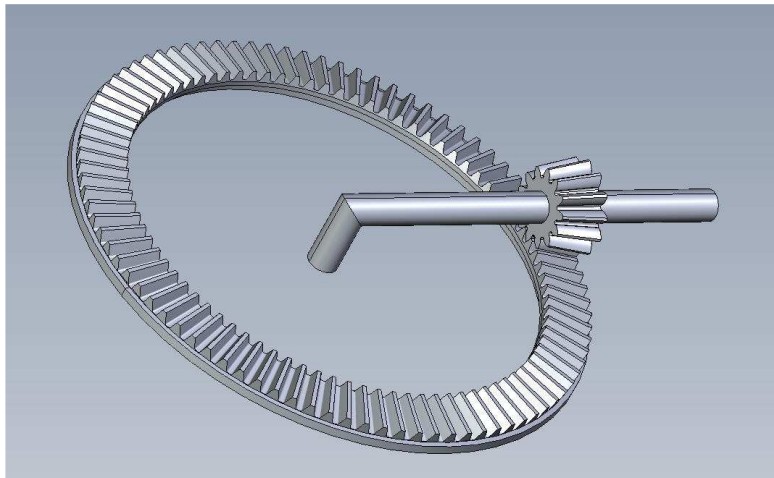


Figure 1. Rack-pinion assembly

To achieve straight bevel gears the design was done thus:

2.1. The design of the part (a straight bevel gear) using CAD program Cametics GearTrax 2008 based on the customer specification. Cametics GearTrax application is a CAD application specialized in designing gears. . After placing gear dimensions, finite part is obtained, figure 2.

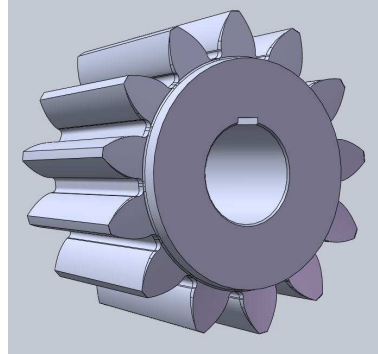


Figure 2. 3D representation of pinion

2.2. After obtaining the design part (bevel gears) it is exported to the application Solid Works. Here you can perform finite element calculations to determine:

- Stress;
- Strain
- Displacements;
- Factor of safety.

Applying the finite element and testing constraints that will face reality realize the calculating elongations tensions, displacements and factor of safety, (see figures 3, 4).

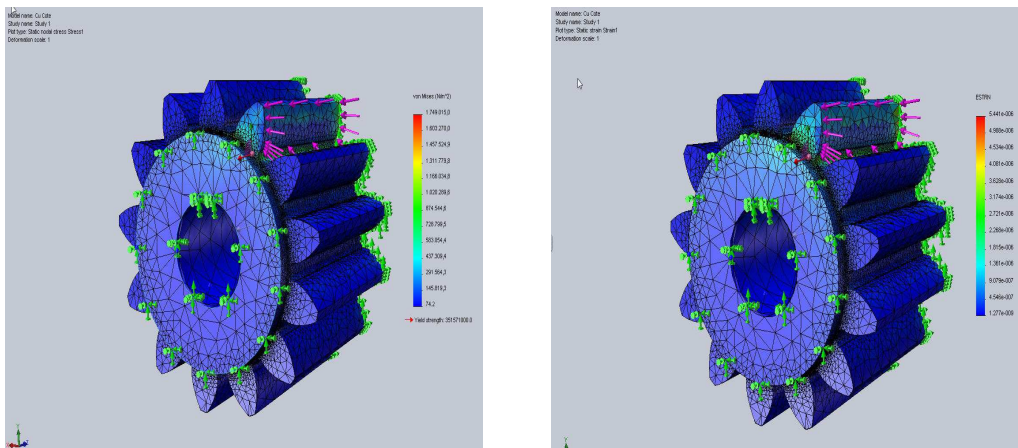


Figure 3. Stress and strain results using FEM analyses

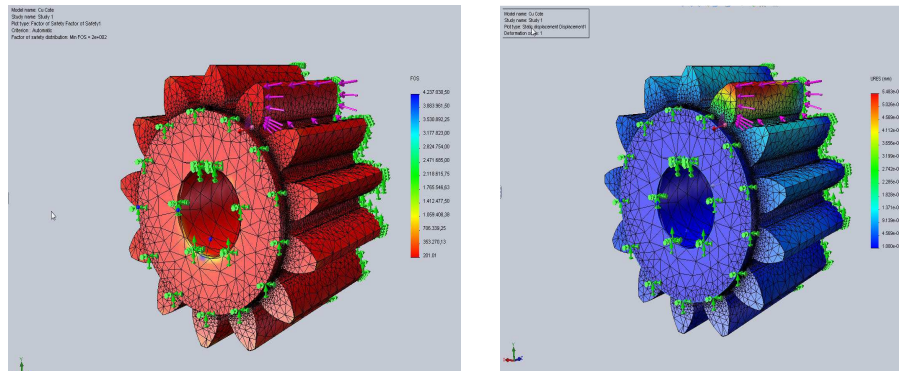


Figure 4. Displacement and factor of safety results using FEM analyses

If the safety factor does not match, we proceed to resize the part or change the materials and we repeat the calculations or we may proceed to optimize automatically the safety factor that suggests solutions to optimize the part[3], [4]. CAE functions provided this procedure of the program SolidWorks 2008.

2.3. After getting the piece into 3D design with all the necessary quotations and optimization being performed it can be passed over to the drawings of the making of the part/piece. They are obtained with the help of SolidWorks 2008 Publisher application. Having the menu drawings, it can be processed by traditional methods on classic machines, direct or by further casting and processing additives on processing cutting machine tools. In this case taking into account the size, it was chosen the variant to cast the piece by traditional methods and further processing of processing additives on the CNC machine.

You can go to get the part drawings after obtaining the part in 3D design with all the necessary quotations and optimization performed.

The help of Solid Works 2008 applications, from Publisher menu, help you to obtain these too [5], [6], [7].

2.4. Processing stock left for machining after casting part can run on numerically routing controlled tool. For this appeals to Cam Works program with which can be removed stock left for machining of the cast work piece. Choose the type of CNC machine that supports the work piece dimensions and executed processing program, which contains:

- Orientation of the work piece on the worktable for processing;
- Selection of cutting tools;
- Cutting operations (milling, drilling, finishing, etc.);
- Number of passes for each individual operation;

- Establishment of the revolutions for cutting tools depending on the surgery performed;
- Control methods for processing;
- Processing precision measurements/measurements of precision of the processing's.

Figure 5 shows the simulation of the processing of chosen part, for example, straight bevel gear on numerically routing controlled tool machine CNC-type DMG DMU 100 T2 [8]. After processing the part, it requires a dimensional inspection with appropriate SDV, and a control surface of the work piece processed and the final size of the piece, which must correspond to those required by the design and implementation needs. If it is necessary, you can still perform debarring operations, fine grinding, sanding, to bring the work piece to the highest quality.

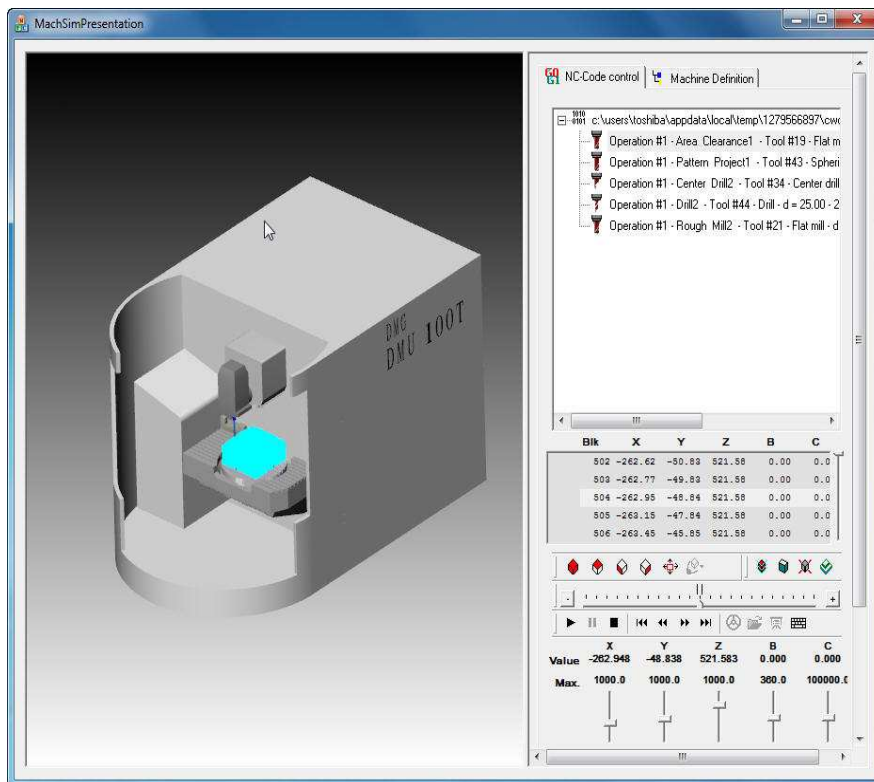


Figure 5. Simulation machining of gear with DMG DMU 100T machine

In figure 6 and 7 is presented finite gear before and after processing.



Figure 6. Gear before processing

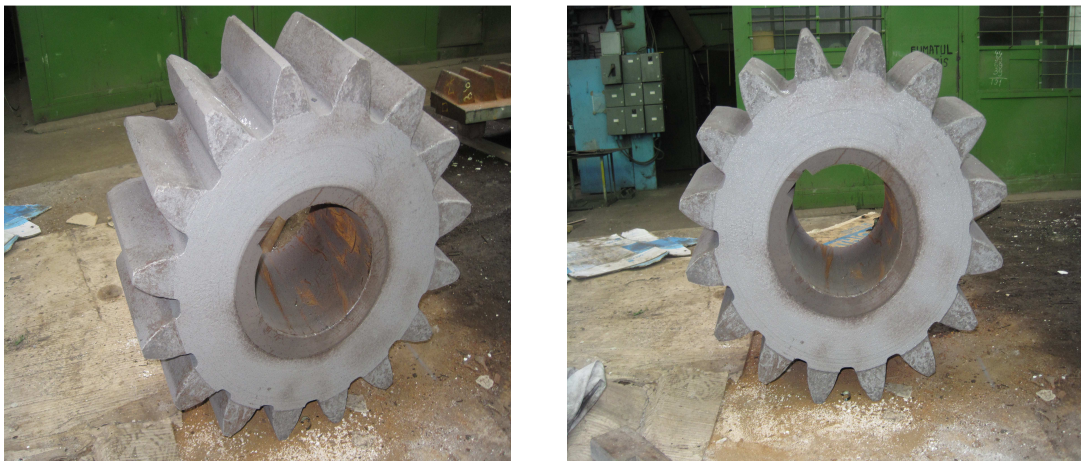


Figure 7. Gear after processing

3. Conclusion

Design, optimization and realization of mechanical parts for continuous casting of metals is an area of great current due to the increased importance that this method of obtaining metal blanks is becoming more used to traditional methods of casting. Studies and research required for upgrading and improving these facilities. Using modern methods and techniques of CAD, CAM and CAE bring a number of advantages over traditional methods of design. Among these advantages are:

- Design is fast, shorter time compared to traditional methods;
- Reducing time and costs, the optimization of assemblies in terms of design and safety factor;
- Achieve rapid prototyping using CAM methods and processing on CNC machines;
- Reduce the massive cost of design, optimization and manufacturing;
- Make time reduced of drawings and the possibility of rapid processing of parts on conventional machine tools, or CNC machines.

The future research and studies of the authors will focus on comparing the various applications of CAD, CAE and CAM on the market, in order to choose the most competitive and fast in terms of initial cost, installation and speed of the work. Studies will have been published in specialized publications, and dissemination will have been made by creating Web pages useful for a rapid transmission of results by experts in the field.

References

- [1] Berce P., Ancau M., Caizar C., Balc N., Comsa S., Jidav H., *Rapid prototyping manufacturing*, Technical Publishing House, Bucuresti, 2000.
- [2] Bogdanov I., *Robot management*, Academic Horizons Publishing, Timisoara, 2009.
- [3] Canau S., *FEM analysis of spur gear systems with misalignment*, Proceedings of DAAAM 2009, Katalinic, B. (Ed.), pp. 261-262, Austria, November 2009, Vienna.
- [4] VELA I., *Proiectarea dispozitivelor*, Editura Eftimie Murgu, Reșița, 1997.
- [5] Vela I., Rădulescu C., Varga S., Vela D.G., *Proiectarea dispozitivelor. Robotică*, Vol. 2, Ed. Didactică și Pedagogică, București, 2006.
- [6] Gillich G.R., *Dimamica mașinilor; Modelarea sistemelor tehnice*, Editura AGIR, București, 2003.
- [7] *** http://www.solidworks.com/sw/support/808_ENU_HTML.htm, [SolidWorks Simulation with Results](#) Accessed on: 2010-05-12

- [8] *** (2010) http://www.solidworks.com/sw/support/808_ENU_HTML.htm, [SolidWorks Simulation Professional](#) Accessed on: 2010-06-13

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