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Application of CAD/CAE Technology in Mechanical Design and Mold design

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Abstract: With the development of the industrial economy, machinery, molds and other products have exhibited functional and diversified features, making it more and more difficult to design and manufacture, and the cost has become higher and higher. In order to meet the high quality requirements of the market, to reduce the difficulty of design and processing, and also to reduce production costs, using CAD/CAE technology for mechanical design and mold design becomes the best choice for major manufacturers. Based on this, this paper starts with the CAD/CAE technology and combines the knowledge learned with a brief analysis of the application of CAD/CAE technology in mechanical design and mold design.
Keywords: CAD/CAE technology; computer; mold design; mechanical design.

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1. INTRODUCTION

CAD is a technical means based on computer technology that simulates physical objects. It can display the structure, color, texture and appearance of objects. CAD is widely used in printing, design, electronics industry, automobile manufacturing, aerospace and other fields. From the perspective of product design, CAD technology has many functions such as design simulation, design modification, version control, standard components, and document output. CAE technology is a method of analytical solution, including steel dynamic response, stiffness, elastoplastic and other solving objects.

At present, commonly used CAD/CAE application software includes Pro/Engineer, UG, Moldflow and so on. Among them, the advantage of Pro/Engineer is mainly reflected in the parametric design. Pro/Engineer has a powerful modeling function, so it is often used for mechanical design and mold design. In particular, Pro/Engineer has the ability to automatically modify the model, which providing a powerful platform and technical support for the model design changes, the staff can complete the design and related modifications on the platform. UG is a three-dimensional modeling software. Although the parametric design function of UG is not prominent, the operating system is so simple that staff can operate on PC quickly. Moldflow is a type of simulation software that is often used for mold design, which facilitates optimization and injection molding. Through simulation design and simulation results, all elements such as materials, locations, deformations, etc. are displayed in an

all-round way, which provides strong support for the staff's design decisions and helps to finalize the final design proposal.

2. APPLICATION AND PRACTICE OF CAD/CAE TECHNOLOGY IN MECHANICAL DESIGN AND MOLD DESIGN

2.1 Application in mechanical design

In mechanical design, the role of CAD technology is reflected in the design and assembly of parts. The requirements for the dimensions, strength, and stiffness of the later parts are mainly determined by traditional calculation methods. The traditional calculation method has a large workload and low efficiency, and the design modification is quite difficult, which is not conducive to ensuring the accuracy of the calculation results. Therefore, CAE technology can be used. Using CAE technology's powerful solution and calculation functions to solve and calculate complex indexes such as strength, stiffness, elasto-plasticity, and heat conduction, the computational difficulty and workload can be significantly reduced. In addition, CAE technology with static and dynamic analysis capabilities can guide the design of part strength.

The mechanical design adopts CAD technology and utilizes the powerful assembly function of the technology to display the components and disassembly processes between different parts. The staff can observe the entire process intuitively. Especially in the assembly and disassembly process, the assembly and disassembly operations are observed using the sequence of CAD assembly functions, and real-time control is performed. The control of the assembly and disassembly of the mechanical components is enhanced, and the accuracy and precision of the design are improved. At the same time, different assembly sequences can be generated through the assembly function, and different assembly schemes can be compared and observed, from which the best assembly scheme can be selected.

2.2 Application in mold design

Mold opening is an important task in the mold design work. The application of CAD/CAE technology has greatly improved the technical content of the mold opening work and has provided a reliable guarantee for mold opening reliability. The structural design of mold products includes many aspects such as size, shape, thickness, and accuracy, and the content is very complicated. The design of the mouthpiece is a part of the mold opening. Firstly, the mold model is established by using the three-dimensional modeling software, and the related model elements are adjusted. Then the computer platform is used to complete the calculation and design work. When designing, it is necessary to consider the issue of design rationality as well as mechanical properties. In short, the basic flow of design work using CAD/CAE software is as follows:

(1) Call the design model. Under normal circumstances, the product design department is responsible for product design, function, shape, size and other aspects of the design work, and the establishment of related models. Afterwards, the completed design model is sent to the mold design department, which is responsible for all subsequent work.

(2) Number of cavity cavities. Usually a cavity multimode arrangement is used.

(3) Button mold and workpiece transfer. After the coordinates of the far point are determined, the corresponding workpieces are transferred to, and the existing model is used to mold the workpiece and set the parting surface.
(4) Design Harvard block and side draw design. In this link, the specific design is mainly based on the product form.
(5) Mold frame transfer. Using the design software to establish the gating system, ejector system and cooling system.
(6) Check. After finishing the above work, first check the quality of mold opening, confirm the error and use the assembly function of CAD/CAE technology to generate the assembly drawing.
(7) Make a part drawing. Based on the specific operations of the above links, the parts drawings are produced, and the accuracy of the parts design is checked to confirm that the accuracy meets the requirements.

2.3 Specific application practice

The application of CAD/CAE technology in mechanical design and mold design allows industrialized, streamlined, and standardized complex design work, improving design quality and effectiveness. The following takes mold design as an example to analyze the application of CAD/CAE technology in design work.

The molds generally work in high pressure and high temperature environments. For example, cold extrusion molds work under high pressure, making the verification work in terms of strength, steady state, etc. particularly important. For this reason, when cold-extruding a die, it is necessary to carefully calculate and calibrate attribute parameters such as strength and rigidity to ensure the quality and safety of the die and ensure that the final product conforms to the use standard. For example, when cold-extruding a process piece, the material is selected from 15# steel, the shape is a cylinder, and the inner spline slot is adopted, and a cold extrusion molding mode is adopted. According to calculations, the size of the billet must be 45mm × 21mm. In order to ensure the strength of the mold itself, UG software can be used for strength calculation. The intensity calculation is divided into the following situations:

(1) For the punch, the UG software is used to give the properties of the punch material, boundary, load, etc., then the finite element method is used to divide the mesh. Finally, the specific given conditions are used to calculate and calculate the stress values of the different parts of the mold. Among them, the maximum stress value is 364 MPa.

(2) For the die, the prestress value is determined before the strength calculation, and the determination of the prestress value is based on the value of the interference. The amount of the interference is obtained by CAE software analysis. First, set a prestress value; then, use CAE software to analyze the deformation and check it against the previously set interference to see if it fits. Repeatedly operating this process, you can solve the correct prestress value. According to this method, the deformation amount of the middle ring of the cylindrical work piece is 0.24mm, and the deformation amount of the inner ring is 0.07mm, and the corresponding prestress values are 600MPa and 665MPa, respectively.

(3) For composite dies, because of too many components, the overall strength calculation is different from the intensity calculation of individual components. When calculating the strength of the composite die, in addition to the finite element meshing for each component, the outer ring and the middle ring, the inner ring and the outer ring must be meshed with the contact surface, and then the prestressing force should be given. Based on the above considerations, the maximum stress on the inner ring die is 1684 MPa, the maximum stress on the middle ring die is 502 MPa, and the maximum stress on the outer ring die is 482 MPa.

(4) The calculation and analysis of the above several cases show that the stress values of the ring, outer ring and inner ring of the barrel type process piece mold are within the permissible range, meet the product design standards and meet the market investment requirements. If the stress value in any of the above areas exceeds the specified range, CAD/CAE technology can be used to modify the design and adjust the design. In short, the mold design mainly includes several kinds of situations such as concave mold, convex mold and combined mold. No matter what mold design is required, the mold itself must have strong strength. First of all, using UG to give properties of punch material, boundary, load and other conditions, and then using the finite element method for meshing, combined with specific given conditions to solve. When the die is designed, the prestress value is determined based on the amount of interference, and CAE is then used to solve the problem. When combining the die, the finite element mesh is divided for each component, and the prestress calculations for the middle, outer, and inner rings are performed.

3. CONCLUSION

CAD/CAE technology is widely used in mechanical design and product development due to its technical advantages. It solves problems in mechanical design, structural mechanics, fluid mechanics, and thermodynamics in the design of the mold by computer, and realizes the simulation and analysis of complex shapes of continuum. It simplifies the complex issues of product design, shape, and other design work, and optimizes product design to improve design quality. In view of the strong advantages and outstanding effects of CAD/CAE technology in mechanical design and mold design, it is necessary to strengthen the transformation of CAD/CAE technology in the field of material engineering and continue to expand the application of CAD/CAE technology to make it more widely used. At the same time, the company continued to strengthen research on mechanical design and mold design technology, integrated intelligent technologies into CAD/CAE technology, promoted further improvement of CAD/CAE technology level, and better satisfied complex, diverse, and high-precision design work requirements.

4. TECHNOLOGY DEVELOPEMENT PROSPECTS AND DIRECTIONS

As the concept of consumers changes, products need to attract customers through innovation. The application of technology can enable designers to make full use of creativity. With the development of computer-based information technology, the CAD/CAE system will develop in the direction of intelligence, and design quality and efficiency will be further improved on an existing basis. The product design process reflects the characteristics of collaboration, intelligence, and full life cycle.

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