Application of CFD Technology in HVAC Refrigeration Engineering

Sun Limin

Electromechanical Department of Huanggang Polytechnic College, Hubei, Huanggang, 438002, China

Keywords: CFD Technology; HVAC; Refrigeration Engineering; Specific Application

Abstract: Under the background of China's accelerating socialist modernization construction, the level of economic construction and the level of modern science and technology are also constantly improving. Therefore, the hardware and software technology of computers in the HVAC project has also been effectively improved. In the traditional sense, HVAC refrigeration technology has limitations in function and performance, which reduces the overall effect of HVAC refrigeration and air conditioning in China. In the later use process, it is more prone to the occurrence of disorder of hot and cold mode conversion, and even it has been found that the air conditioning and refrigeration performance is not good due to process problems during the construction and installation process. In order to effectively solve the above problems, this paper will elaborate on the new CFD technology to ensure that the problem of insufficient HVAC refrigeration can be fully solved.

1. Introduction

The CFD technology has many advantages in HVAC refrigeration projects. It not only does not require high construction costs, but also has a certain improvement in speed. From the perspective of the storage of knowledge materials, CFD technology not only from basic functions and Performance has been improved, and the basic principles are used to improve the efficiency of refrigeration engineering. The CFD technology is actually a simulation technology that can be used in the field of building HVAC to perform a good simulation evaluation of indoor airflow and air quality, and to optimize the content of the architectural design to provide designers with Based on the basis.

2. Application Characteristics and Principles

2.1. Application characteristics

In general, mathematical physics models are specifically addressed in fluid descriptions for fluid problems[1]. For the field of HVAC refrigeration, basically the fluids studied are incompressible viscous fluids. The mathematical physics model involves multiple governing differential equations, including mass conservation continuity equations, momentum conservation equations and energy conservation equations. These three parts, and these incompressible viscous fluids basically belong to the turbulent flow, so it is necessary to solve the problem by combining the corresponding turbulence model, and perform numerical solution[2] on the basis of the complete description.

2.2. Numerical method

Due to the actual operation process, different solution regions and discrete methods of different control equations are solved by numerical methods. The discrete methods selected in the existing numerical methods of fluid mechanics are as follows: limit difference method, boundary element method, finite volume method, finite element method and finite analysis method. Specifically, it is necessary to discuss separately according to the actual situation. In the aspect of HVAC refrigeration, in order to solve the problems of incompressible, low-speed flow and heat transfer, it is necessary to use the finite volume method to carry out the discrete, finite volume method itself using the physical point of view to achieve discrete, in each The finite volume guarantees that the conservation equation between physical quantities can form a discrete equation corresponding to it,

using clear physical concepts, and the coefficients in terms of discrete equations have a certain physical representation[3]. After the equation is discretized, the algebraic equation has replaced the differential equation, and the corresponding calculation method is used to solve the numerical value, and the discrete specific flow field distribution can be obtained.

2.3. Results are visible

The result can be visualized by using computer graphics technology to analyze the flow fields of CFD. The flow field includes the contents of velocity field, temperature field and concentration field. The result can be visualized for the above content, that is, Through the CFD analysis results, the above content is visually expressed.

2.4. Application principle

The various modules of CFD technology play a key role in the HVAC refrigeration system, and the specific application process, especially for the front-end processing module, should be given full attention, because the relevant data of the HVAC refrigeration system needs to be calculated. Formed in the front section. It is then built by the preliminary modeling and data entry module to implement the data network. At the same time, the core computing functions of the system technology are constantly running. On the basis of ensuring data analysis, the results are provided to the CFD background module, which facilitates practical application in the process of use, but in the HVAC to CFD In the process of application of the technical module, we should ensure the parameters and cycle operation principles in each module to ensure that these parts can be effectively utilized, so as to ensure that the operation of the HVAC refrigeration system can be well reflected.

3. Application Content

The CFD technology can not only predict the flow characteristics of fluids, but also achieve mass transfer separation and dissolution operations, conduct flow, convection and radiation in the heat transfer process, and achieve solidification in the process of phase change. In addition to boiling, in addition, CFD technology can also perform simulation operations on mechanical deformation for mechanical motion, such as turbine movement and mast bending, which can be seen as a guiding role for HVAC refrigeration technology.

3.1. Indoor airflow organization

In order to detect the HVAC cooling effect inside the space, it should be studied for the airflow organization in the room. In the process, CFD technology can be used to simulate the indoor airflow organization form, and the detailed distribution of airflow related parameters inside the space can be predicted according to its performance, and the guiding design of the ventilation and air conditioning system can be realized. Generally speaking, the ventilation and air-conditioning space will be divided into two parts, one is the ordinary space used by the user to live and work, and the space will include a taller high-profile design, etc. The other one refers to the public. The space of the place, that is, the special space of the hospital, subway passage, etc.

3.2. Exterior environment of the building

The influence of the external environment of the building itself on the internal environment cannot be ignored. Nowadays, the thermal environment of the building community and the secondary wind have gradually become the focus of people's daily attention[4]. In the HVAC project, the CFD technology is used to simulate and analyze the relevant parameters of the external environment of the building, and the wind environment outside the building is carefully designed to use the natural ventilation design inside the building. The HVAC refrigeration system provides effective guidance.

3.3. Engineering equipment performance

From the design of the HVAC refrigeration system, there are many devices that use the working fluid flow to realize the energy conversion process. For example, the refrigeration machine, refrigeration pump and fan are all operated according to this working principle. Therefore, the overall flow of the working fluid has a great influence on the performance of the equipment. In the working process, the CFD technology is used to simulate the flow state of the fluid in the equipment[5]. Therefore, it is possible to understand the performance of the device, and it is convenient for the relevant staff to improve and help the performance to achieve more efficient improvement.

3.4. Problem analysis and pre-processing

In the process of properly defining the simulation target, and Li Jianhua for the physical problem, it can ensure that the reasonable simulation method can be confirmed. In the process of defining the simulation target, it is necessary to confirm for various types of problems. The results of pressure drop, mass flow rate and resistance are well studied. In the analysis process, the use of the above content, simulation progress, time and calculation results can be well planned and confirmed. After that, it is necessary to perform the calculation of the scope of the domain to ensure that the problem can be completely separated in the system, and confirm the start and end of the calculation domain[6]. In addition, you should also confirm the content of the boundary condition information, whether the boundary condition type can fully match the information, and confirm the reasonable data position for the boundary of the calculation domain, and simplify the problem as much as possible. The dimensional symmetry problem and the axis symmetry problem help the relevant personnel to solve the specific problem effectively. Also, the geometry unit type is selected according to the complexity of the geometry and the flow characteristics. Generally speaking, if it is a simple geometry, the grid quality of the quadrilateral and the hexahedron is higher, and the number of units is smaller. But this is only compared to triangles and tetrahedrons.

3.5. Solver execution

In the process of the solver execution, it is necessary to select a numerical model, such as turbulence, combustion, and multi-phase flow, etc., and the corresponding physical model needs to be selected. For material properties, it is the confirmation of fluids, solids and mixed materials. In addition, confirmation of working conditions and boundary conditions is required, along with initial values. The solver control parameters, such as the relaxation factor and the Coulomb number, are confirmed, and the convergence monitoring curve is set accordingly. In the process, the numerical iterative process of the discrete conservation equation is also converged. Finally, in order to improve the progress of the solution, we must make a corresponding comprehensive judgment on the convergence criteria and the progress of the convergence solution.

3.6. Post processing

After the calculation convergence is performed, convergence should also be performed for the calculation result, and valid data is extracted therefrom for the result of checking the calculation. Generally, the effective data extraction methods for the data include color images, curves, and physical quantities, respectively. There are three ways to report numerical values. In the process of analyzing the results, the revised model should be further obtained to obtain more ideal calculation results.

4. Application Area and Function

4.1. Application fields

In the process of building design, it is indispensable to consider the problem of refrigeration and internal airflow, which requires room airflow to have a certain degree of influence on temperature and air quality. In the process, these two elements are optimized and on-demand cooling. Ensure the

effectiveness of the equipment. In the process of applying CFD technology, it can also be calculated for air-conditioning airflow, and then predict the airflow distribution. After the indoor environment is analyzed, the factors that easily interfere with the environment and boundary conditions and initial conditions are made. Good adjustment, the solution to the above problems has an important impact on the refrigeration efficiency of HVAC itself. Therefore, the monitoring function of CFD technology should be effectively applied, which can help field designers to understand the specific situation of indoor airflow, so that the overall structure can be more efficiently optimized, ready for improvement in cooling capacity and efficiency.

4.2. HVAC refrigeration

For the actual function of HVAC, the refrigeration capacity of the equipment is also one of the most concerned issues. The performance of intelligent efficiency directly determines the pros and cons of HVAC. Generally speaking, in HVAC, it is necessary to judge the performance of the equipment according to the fluid movement condition, and according to the situation, the HVAC is effectively modified. Among them, for the improvement of the fan equipment, not only the cad software should be used to design the plane body of the fan device, but also the CFD technology should be used to generate the relevant mathematical model, mainly because the CFD technology itself has the flow display and the grid. The generated functions, so it can help the fan equipment to improve the related work execution time saving and efficient division of labor. In addition, it is necessary to divide the work for different sections. Since the CFD technology has been properly reduced in the calculation work, the difficulty is reduced. After the calculation for the mathematical model, it can be effectively analyzed for the relevant working conditions of the fan device. This is a process that needs to be judged. It is necessary to make specific analysis and judgment for the fan to form a comprehensive analysis of the device. .If the imperfect part is found in it, it needs to be improved in time, and only in this way can the fan unit be effectively improved, and the overall cooling effect of the HVAC system can be effectively improved.

4.3. Basic functions

The main workflow is to establish the governing equation first, to deny the initial conditions and boundary conditions, and to use the means of dividing the computing network to generate the computing nodes, establish discrete equations in the process, and then confirm the discrete initial conditions and boundary conditions. Then, the corresponding solution control parameters are given to confirm whether the convergence is converged. If the convergence has been confirmed, the calculation result can be directly displayed, otherwise the calculation is returned. Specifically, the specificity of the fluid flow is specifically tested, and the heat conduction and transmission functions of the equipment in the refrigeration are arranged, and the external pressure received by the equipment is adjusted to reduce the actual deformation. In the actual application process, the optimization of its content is inseparable from the role played by CFD technology. CFD technology has important application value in the field of HVAC refrigeration equipment. In addition, CFD technology itself can perform many functions through coordinated operation, such as maintaining the stability of HVAC system operation, using its front-end modules, data modules and background processing modules to improve the operating efficiency of HVAC refrigeration equipment.

5. Conclusion

At present, CFD technology has been widely used in HVAC refrigeration projects. It can not only solve the problems in the field of HVAC refrigeration, but also focus on heat and mass transfer issues. The efficiency and stability of the air conditioning refrigeration system are comprehensively improved. We must also do a good job in system training and analysis of talents for CFD technology, effectively analyze and infer the problems existing in them, and make the specific content systematically popularized and popularized.

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