Computer Simulation Techniques

1. Introduction

Computer simulation techniques (Computer aided engineering: CAE) is considered to be one of the core technologies for manufacturing industries to achieve "21st century production" that is characterized by short lead times, low production cost and high product quality all the while being compatible with an environment-friendly society. Supported by the astounding pace of progress in information technology (IT), computer simulation has made it possible to reproduce "actual" objects on a screen without limitation of time or space, thereby permitting it to be studied repeatedly at a practical level.

In modern industrial circumstances, not only has experimentation with actual objects but also computer simulation has become widely employed to optimize processes, structures and systems. Some examples of the application of computer simulation are introduced below.

2. Characteristics of Computer Simulation Techniques at NPD

The System Engineering Department of Nittetsu Plant Designing Co., Ltd. owns the following technologies necessary for computer simulations: (a) various programs and applications for nonlinear structural analysis, 3D-CAD, dynamic structural analysis, fluid-flow and heat transfer analysis and magnetic field analysis, (b) techniques to build and utilize the latest computer hardware, including PC clusters, and exclusive network environments, and (c) application/evaluation techniques accumulated mainly for equipment design and engineering of steelmaking plants.

The System Engineering Department offers its techniques in optimum combinations to address specific problems. Working with Nippon Steel, it contributes to solving many different technical problems involved in engineering for some 200 projects in a year.

3. Application Examples

Three specific examples in which the computer simulation techniques used by NSC helped solve specific problems are given below.

(1) Structural analysis of top cone for a large-scale, high-pressure blast furnace (see **Fig. 1**)

With the aim of prolonging the life of a large-scale blast furnace and improving its operational stability, the stress and rigidity of each of the blast furnace parts under fluctuations of in-furnace pressure and temperature at the furnace top were evaluated. In addition, a study to optimize the furnace structure was made.

(2) Analysis of fluid-flow and heat transfer in the combustion chamber of a direct melting furnace (see **Fig. 2**)

The fluid-flow and heat transfer, including gas/solid combustion, convection and radiation heat, in the combustion chamber for burning combustible gas and char generated by the gasification/melting furnace of the "direct melting/recycling system" were analyzed. The calculation results (temperature, gas concentration and flow rate) were used to decide various parameters to ensure optimum combustion in the furnace.

(3) Analysis of U-shaped damper under cyclic load (see **Photo 1** and **Fig. 3**)

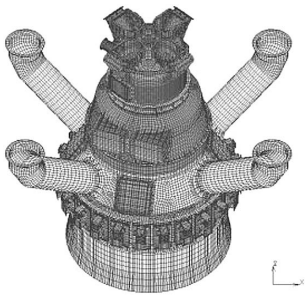
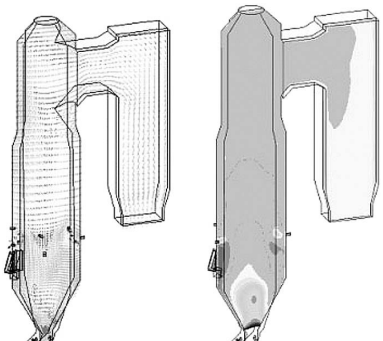


Fig. 1 Structural analysis model of top cone for large-scale and high-pressure blast furnace



(a) Velocity field **(b) Temperature distribution**

Fig. 2 Numerical analysis result of fluid-flow and heat transfer in combustion chamber of Direct Melting System

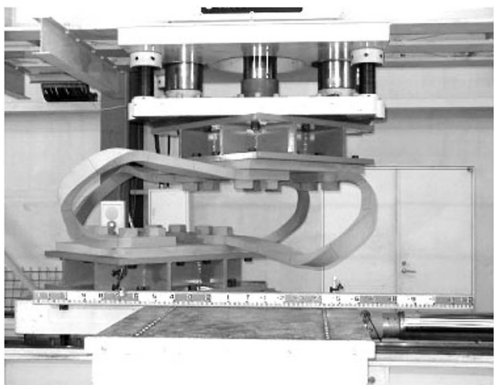


Photo 1 Performance test of U-shaped damper

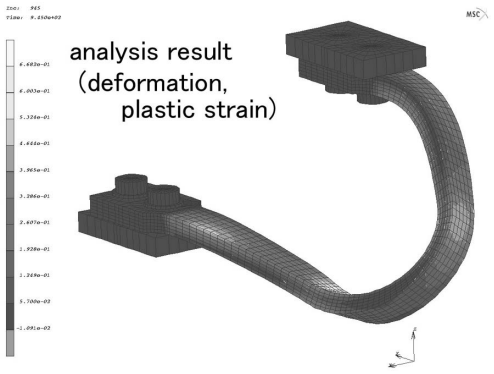


Fig. 3 Structural analysis result of U-shaped damper under cyclic load

This analysis was carried out jointly with the Building Construction Division of NSC for the development of a U-shaped damper. Various characteristics of the damper, including its restoration force and fatigue, were studied, and the study results were used to decide the optimum damper shape.

For further information, contact
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