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The implementation of the integrated design process in the hole-plan system

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ABSTRACT: *All current shipyards are using the customized CAD/CAM programs in order to improve the design quality and increase the design efficiency. Even though the data structures for ship design and construction are almost completed, the implementation related to the ship design processes are still in progress so that it has been the main causes of the bottleneck and delay during the middle of design process. In this study, we thought that the hole-plan system would be a good example which is remained to be improved. The people of outfitting division who don't have direct authority to edit the structural panels, should request the hull design division to install the holes for the outfitting equipment. For acceptance, they should calculate the hole position, determine the hole type, and find the intersected contour of panel. After consideration of the hull people, the requested holes are manually installed on the hull structure. As the above, many processes are needed such as communication and discussion between the divisions, drawings for hole-plan, and the consideration for the structural or production compatibility. However this iterative process takes a lot of working time and requires mental pressure to the related people and cross-division conflict. This paper will handle the hole-plan system in detail to automate the series of process and minimize the human efforts and time-consumption.*

KEY WORDS: Hole-plan system; Hull and outfitting design; Process automation.

INTRODUCTION

In the traditional design environment, the designers had been satisfied that the CAD/CAM system could provide the drawings for products. However, the expectation of the shipbuilding CAD/CAM has been updated around these days (Mistree et al. 1990). Many major shipyards are deploying 3D product model to support the variety of requirements, such as factory automation data, reproduction of the data and the detail product information.

Among the current issues for the development of integrated design support system, this paper focuses on the process automation (Andritsos and Perez-Prat, 2000) which, in general, are occurred between the related several divisions. For this, the design information management system which can reflect the ship design process and solve the process conflict is certainly needed. The generation process of outfitting holes is the typical example which needs the co-work between the outfitting and hull design divisions. The difference of design-time, work scope of each division, and the numerous revisions are the main reason why the hole-plan system should be automated.

To solve this complicated process on the outfitting design, a Bill-of-Material (BOM) approach has been introduced and suggested by Lee et al. (2010) and Lee (2010). However there are a few studies directly related to the hole plan system. The

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related studies had been implemented by Ye and Kim (1992), Lee and Kim (1992) and Suh and Lee (2006). At that time, the outfitting division did not have the same CAD system with the hull structure division. These researches, therefore, had tried to solve the interface problem between the two different systems. For reference, the major shipyards are recently using the unified CAD system. So we are going to focus on the process automation which includes the generation of virtual holes, the management of holes history, the insert of automated hole on the panels, and the hole visualization connecting with CAD system, instead of the interface problem. Based on the concept of this article, we have developed the hole-plan system and the detail processes are explained on the remaining chapters.

THE CONCEPT AND DEFINITION OF HOLE-PLAN

Holes on the hull structure

There are many kinds of holes on the hull structure. They are used for the various purposes which include the passage usage (Access hole, Man hole), the discharge usage (Drain hole, Air hole), the welding or assembly usage (Scallop, Slot), and lightening usage (Lightening hole) or the special usage (Lashing hole, etc.). Here, the lashing hole is used for tightening the cars on the Pure car and Truck Carrier (PCTC) ship, and the lightening holes are also made for the load dispersion, passage usage, besides the weight reduction. Additionally, the outfitting holes which are the main theme of this article consist of the pipe holes, the ventilation holes, and cable holes. Fig. 1 shows the outfitting pipe network on an engine block.

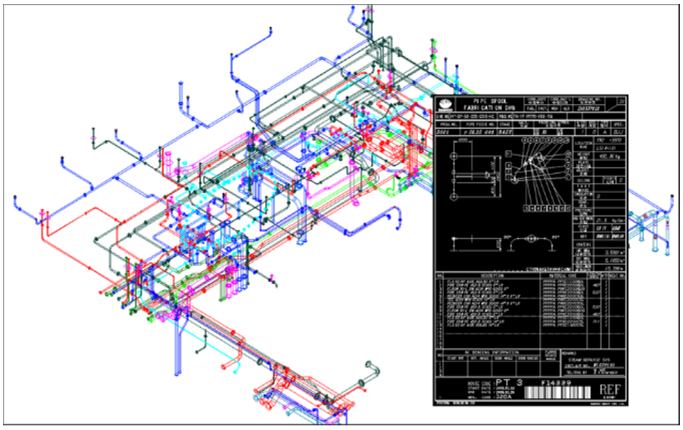

Fig. 1 A piping network on the engine block.

Generation process of outfitting holes

Fig. 2 describes the overview of the developed hole-plan system which compares “As-Is” and “To-Be” being developed. In case of “As-Is”, the people of outfitting division should make the complicated hole drawings (refer to Fig. 3, Ye and Kim, 1992) which could indicate the exact position, type of holes and the target hull panel. For reference, the hole drawing had been used as

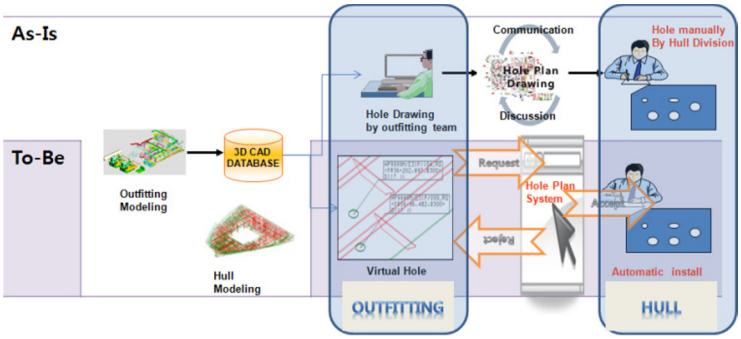

Fig. 2 Overview of the hole-plan system.