AUTOMATIC CONSTRUCTION QUANTITY CALCULATION SYSTEM

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ABSTRACT: The current ways to determine construction material quantities: calculating manually or using evaluation computer software, are time consuming and lack of accuracy. This study proposes an automatic calculation system to compute construction material quantities using a three dimensional architecture model based on CAD image files. The proposed system reduces the errors produced by manual input, increases the accuracy of calculated quantities, and reduces the calculation time. A comparison of the manually calculated quantities and those calculated by the proposed system confirms the accuracy of the proposed system.

***Keywords**: Material Quantity, Construction, 3-D Model, Automation System*

1. INTRODUCTION

The rapid growth of information technology has led to innovative computer applications that increase efficiency in the construction industry. For example, computers are well suited to computing the quantities of construction materials required for a project. There are currently two main ways to determine construction material quantities, such as the amount of formwork or the volume of concrete in walls, beams, and columns: calculating manually or using evaluation computer software. These methods are time consuming, and may be inaccurate due to accumulative errors and typos produced from data entry manual computing, overlooking some areas, or a lack of experience in performing calculations. This study proposes an automatic calculation system to reduce the errors produced by manual input, increase the accuracy of calculated quantities, and reduce the calculation time.

2. METHODOLOGY

AutoCAD is one of the most frequently-employed software for drawings. Design drawings are typically plotted in 2D using AutoCAD. Though the Drawing Files (DWG) file format is exclusive to AutoCAD, AutoCAD provides a function to transfer DWG files to the Autodesk Data Interchange file format (DXF) [1]. This paper uses the inner data of DXF files to build a 3D structure model for calculating the quantity of concrete and formworks.

The proposed system adopts the C++ language to develop the system by importing the classes of Open GL [2]. The development of windows, menus, tools of the system implements the Application Frameworks (AF) of Microsoft Foundation Class (MFC).

After inputting the floor plan, structural drawing, details of openings (i.e. doors and windows) and stairs, and sectional drawings, the system can build a 3-D model of a building structure, as Fig. 1 shows. Clicking on the elements of the 3-D structure model automatically generates the quantities information of volume and surface areas of the element, as Fig. 2 shows. This quantity calculation considers the intersections of beams and columns, and thus provides accurate volume quantities and element surface areas. This information can be transferred to excel files for future usage in material and cost estimations, as Fig. 3 shows. A comparison of the manually calculated quantities and those calculated by the proposed system confirms the accuracy of the proposed system.

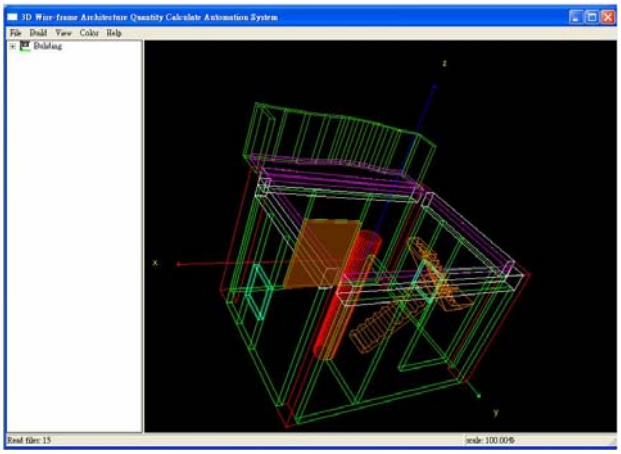

Fig. 1 3-D model of a building structure.

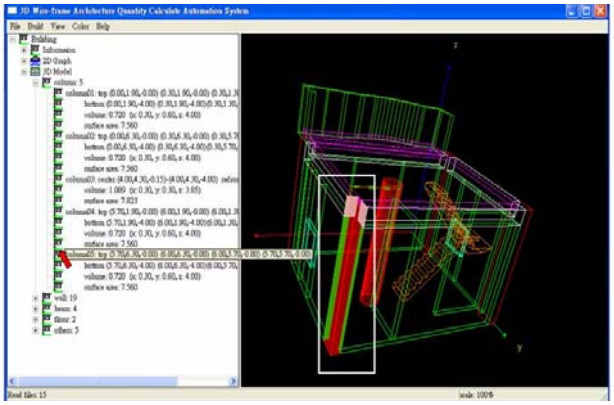

Fig. 2 Quantity information of a selected element.

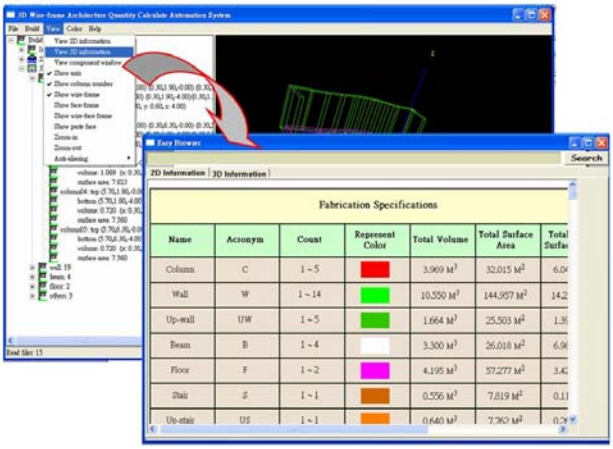

Fig. 3 Quantity information transformation.

3. CONCLUSIONS

This paper proposes an automatic method of calculating construction material quantities. The proposed system uses a three dimensional architecture model based on CAD image files. Through a transformation matrix and vector computation, the system calculates and presents the material quantities (i.e., amount of formworks and volume of concrete) of each component users need. This provides an easy user interface for construction engineers to calculate construction material quantities automatically and accurately using a 3D wire-frame architecture structure, reducing manpower and enhancing accuracy. The proposed system focuses on calculating the volumes and areas of structure elements in building structures. This system does not consider the calculation of steel bar length, which remains a topic for further research.

REFERENCES

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