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CAD SYSTEM FOR CHINESE TRADITIONAL ARCHITECTURE

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Abstract. This paper discusses an undergoing project for an AutoCAD based CAD system for Chinese traditional architecture (CTA) called ARCHISTORY. It covers three main aspects of CTA research: field survey, structural and constructional research, and preservation and restoration design.

1. Background

Each year, the second year students from School of Architecture, Tianjin University will be organized to take part in field trips, as a required course, to measure and draw groups of Chinese ancient buildings, most of which are national historic sites or even world cultural heritages. These field trips, while giving the students' synthetic training in their professional abilities, have covered most of the China's provinces and collected tens of thousands of essential and valuable materials for research and preservation of these historic monuments since 1950's. Meanwhile, based on the measuring data and drawings, the teaching staff has been carrying out research work on Chinese traditional architecture, and pursuing preservation planning and design for historic buildings. Thus, survey, research, and design constitute a chain of essential work in our Chinese architectural history research. Since the great improvement and success of the computer technology, the three interrelating aspects today are facing a common ground: computer aided drafting, data processing and design.

In fact, we began to introduce computer in our work as early as in 1991. From then on, computers have been so prevalent among architectural students that it became feasible for all students to finish their fieldwork drawing with computer. However, from the very beginning, we have been faced with a big obstacle: no appropriate specific software for Chinese traditional architecture (CTA) at all. Actually, most preservation institutes and firms in China use no more than AutoCAD or other general software as drafting tools that is terribly time-wasting and far from full use of computer. To meet the needs of the three aspects of CTA research, we are developing an AutoCAD based CAD system called ARCHISTORY.

2. Characteristics of Chinese Traditional Architecture

Since most Chinese monumental buildings are of timber structure, the discussion in this paper is restricted within Chinese timber-structured architecture.

2.1 SIGNIFICANT FEATURES OF CTA

The immediately notable feature of CTA appearance is the concave curved roof with overhanging eaves, which is supported by a timber skeleton based on a raised platform (Fig. 1). The timber skeleton or so-called "major carpentry" plays an essential role in the construction of CTA, so "the study of the Chinese building is primarily a study of its anatomy. The section drawings are much more important than the elevations."(Liang, 1984)

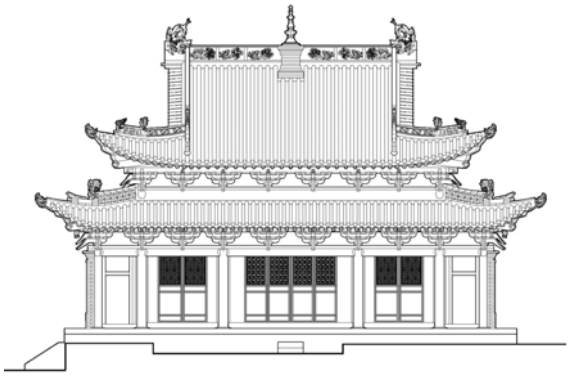

Figure 1. Elevation of a temple hall, Gansu, 1427

Another significant feature is its module system, which is similar to Greece temple. With certain rules and a basic module, *cai* or *doukou* or column diameter, the main dimensions of a building and the sizes of almost all structural members can be computed. For example, a series of computing tables on construction in Beijing in the Qing Dynasty (1644—1911) are published (Ma, 1995).

However, it must be pointed out that although all prototypes of CTA composition and elements can be established according to a set of modular regulations, they virtually have numerous variations due to different times, territories and schools. It has been proved by a great deal of site measurement that there does not exist a general regulation for all, even in the same period and territory.

2.2 PRACTICAL REQUIREMENTS

- Survey drawing. As mentioned above, the starting point of the CTA research and preservation design program is the filed survey or measurement, so it is of great importance to create, at least, a convenient and effective drafting toolbox. Apart from manual measurement, which, for economical and time limit, is the normal method, we also have photogrammetry system for special building measuring and total station for site survey. The data captured by them should be easily transferred into AutoCAD based toolbox. And since an individual building is generally measured by a group of two or three people, it is also important to build a checking system to make sure that each drawing is basically right.
- Scanning and vectorizing previous manual drawings.
- Drawing archives management.
- Preservation design and restoration design or pseudo-classic design.

3. System of ARCHISTORY

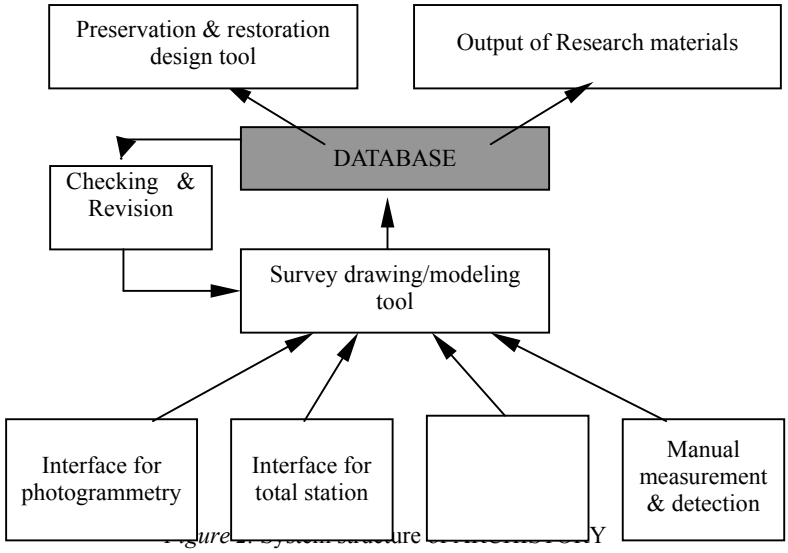

Figure 2. System structure of ARCHISTORY

3.1 SYSTEM OVERVIEW

As implied in Figure 2, ARHISTORY system begins with data capture, and, by analyzing and processing in the database, the data and regulation can be reused and extended during the design phrase. The whole system is a self-

maintenance and self-expansion system, which has potential to be developed into an expert system.

3.2 ENGINEERING DATABASE

Apparently, the engineering database plays a key role in the whole system. It is made up of the following items:

- Drawing information manager
- Database for individual building (case library)
- Data analyzer for construction regulation
- Standard element library
- Special element library
- Other database concerned

3.3 SURVEY DRAWING/MODELING TOOLBOX

Since survey drawing is the starting point and created for reuse, instead of as mere drafting tools, the toolbox is made highly parameterized and linking with external database. With ASE/ASI, extended data, and block attributes provided by AutoCAD, the data and information of a building and its drawing can be so properly organized that when a drawing, 2D drafting or 3D model, is finished, a linked external database is created as well. In another word, the toolbox is an interface of data input rather than mere drafting tools.

In addition, the toolbox has three interfaces for other form of data capture: interface for photogrammetry, interface for total station, and interface for vectorization of previous manual drawings.

3.4 CHECKING AND REVISION

The data fed back from the database can be used to check the validity of a drawing or model; when the drawing is revised, its linked database in turn is automatically updated. Although the checking function can only be partially realized by the system, it is helpful for the teaching staff to achieve quality control of drawings.

3.5 DESIGN TOOLBOX

Apart from the drafting and modeling function of the survey drawing toolbox, the design toolbox is supported by the powerful engineering database. And since there is no general regulation, the design tool is partially Case-studied

based, and the resources from field measurement can be reused and self-adapted.

References

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