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CAD System in a General Contractor

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1. Preface

The development of CAD (or CADD) (Computer-Aided Design and Drafting) system was historically initiated by technology-intensive and large-sized industries such as aerospace and automobile makers with their huge amount of investment. Such movement now wideley influences many other industries together with the recent advance of sophisticated software technology as well as the rapid decline in hardware cost. A general contractor can not be an exception.

Kajima Corporation instituted five sets of turn-key CAD systems in the early spring of 1982. And succeedingly, they all began to be used for actual design works after the first stage of software development in last November. Since other Japanese general contractors are also concerned with CAD systems, the competition in design automation would be an immediate focus among Japanese contractors for next five years.

2. Introduction of CAD System

Kajima was the first Japanese general contractor that introduced a large-sized digital computer in 1963 at its head office computer center. Since then, its central computer system was frequently renewed and replaced by larger systems. At present, its host computer (M-280H) can compute with the speed of 30 MIPS. About 80 sets of medium-size computers are now installed in our nine branches and many construction sites. At the same time, considerable number of personal computers (about 350 sets) are supplied to many engineering departments in the Corporation.

The introduction of plotters (CALCOMP) in 1968 made the direct output of graphic information possible with our computer system. At that time, installation of the plotters helped make a remarkable improvement of the efficiency of our entire computer processing procedure. For example, in the case of our land preparation planning, about seventy percent of design drawings could be produces with our system. Such application marked the beginning of the CAD with batch processing devices.

An initial CAD concept with an interactive graphic mode was introduced in 1977 as a next step. Several graphic display terminals were installed after the TSS function could be fully satisfied with reasonable cost-performance. Various application softwares for planning of design objects were developed, for example, for buildings, roads and dams. The quality of our computer output was rapidly improved with the progress of our hardwares.

However, when we desire to have a comprehensive system, i.e. fully-automated CAD system as our design tool, we need to build the ability of dealing with different kind of graphic information and simultaneously should have a reliable data base structure in our computer system. Therefore, we had to decide whether we should develop our own system with our effort or employ some already-established CAD system.

Kajima chose the latter and introduced the following five systems:

- CADAM (CADAM)
- CATIA (Dassault Systems)
- IGS-500 (CALCOMP)
- DESIGNER (Computer Vision)
- CALMA/DDM (Calma)

3. Development of CAD System

The works to be undertaken by a general contractor should cover all the phases of a construction project, i.e., planning, design and construction on site. However, ready-made turn-key CAD systems currently available in the market have their own advantages and disadvantages, so that we could not apply them to our jobs directly. In other words, we might say that no single CAD system is enough for performing our various design jobs in expeditious manner. This was the primary reason why we had introduced five different systems at the same time.

The design objects in Kajima were first classified into some categories like civil engineering structures and large facilities for energy plants as well as general office buildings. Next, some common fundamental functions were extracted among the aforementioned desing objects. They included design drafting, structural analysis, data transformation interface and system handling capability. Some staffs from our computer department were assigned to each such function in order to develop the corresponding softwares. They formed a working group for each function.

The jobs with which the design-drafting team had to deal were the work sampling analysis, review of our drawing standards and the development of application programs. Structural analysis group tackled the enhancement of structural analysis capability stored in our host computer and next developed the common data base useful for analysis. The effort of our interface group was directed toward the development of the neutral data base and pre- and post-processors. Finally, our system handling group worked to establish the management method to unify various computer resources and make an educational program for our CAD engineers.

4. CAD Applications

Special features of our five CAD systems and their application fields are briefly described.

- IGS-500

Only two-dimensional drafting is possible. Its maneuverability and response are excellent. This system is primarily used for designing housing units.

- DESIGNER

This system is very flexible in having many standard fundamental operations. In Kajima, it is used to design civil engineering structures together with some analysis computation.

- CALMA/DDM

A three-dimensional modelling function is relatively well equipped. This system is provided for designing large energy facilities.

- CADAM

This system is basically for two-dimensional design and very excellent in its maneuverability, response time and reliability. It is used as pre- and post-processors for design drafting and structural analysis.

- CATIA

This implements the most sophisticated three-dimensional modelling functions and possesses the common interface to CADAM. It is used to model a very complex shape of structure and to check the interference among structural component members.

5. Future Prospect

A term "Turn-key CAD system" sometimes causes us to misunderstand. In our case, it took about one year to analyze our design procedure and succeedingly establish our CAD concept. Another half year was inevitable to develop elementary softwares after system installation. Thus, we might describe our CAD experience as "One year for making a key itself and another half year for opening a black box".

Our whole five CAD systems now work well and we could accumulate some experience to promote their efficiency. However, our CAD technology still resides in its infancy stage, when viewed from the ideal form of entire CAD procedure.

There are several purposes which the ideal CAD system should be equipped with. The first one is obviously to improve the productivity in the design process. The next one is for improving design quality with the integration of necessary design information. The last one is to achieve some efficient management method for various designs. Honestly speaking, our present technical level has just reached the entrance of the first target. Thus, we would like to continue our effort until the other aforementioned goals are accomplished.

In any event, we might anticipate some favorable situation for CAD system in quite near future. For example, hardware cost reduction, format standardization of graphic data and advancement of data communication method can be expected. Thus the CAD network with many terminals would be soon available within reasonable cost. Furhter, the present CAD system would be extended to control different kinds of robots working in fields and at the same time used as a daily practical O.A. (Office Automation) tool even to average design engineers.