RESEARCH AND USAGE OF CAD AND THE FIFTH GENERATION

- present status of CAD use in Japan -

CIB/W78 Colloquium London, June 5-7 1984

Tatsuo Terai, Dr.
Building Research Institute
Ministry of Construction, Japan

1. Introduction

There are so many building engineering firms and construction companies in our country. They are facing with strict competition at home and abroad and making efforts to devise new technologies with higher cost effectiveness and performance. CAD is considered to be one of the most effective and powerful tools. FA (Factory Automation) and OA (Office Automation) have been increasingly introduced in major companies and offices, and many types of application systems related to their various fields of activities have been developed and expanded. In this change of technical surrounging of building engineering field in Japan, it is getting a common consideration that system integration is a key point to attain their final objectives.

In this paper, three separate items related to integrated CAD system in our country are described in brief.

		1970	1975	1980
public corp. for tele-communication	NTT : NIPPON TELEGRAPH & TELEPHONE PUBLIC CORP.	DEMOS DEN-DEN MULTI PURPOSE ONLINE SYSTEM	DEMOS-E DEMOS EXTENDED	DEMOS
general contractor	SHIMIZU : SHIMIZU CONSTRUCTION Co.	$ 3.8 billion sales in fs 1982		STEP(1,2,3) SHIMIZU TOTAL ENGINEERING PROCESS
	TAISEI : TAISEI CONSTRUCTION Co.	$ 3.6 billion		SPIRIT (ARC) SKILLED PROPOSAL & INTEGRATED RAPID INFORMATION as a TOTAL SYSTEM
	KASHIMA : KASHIMA CONSTRUCTION Co.	$ 3.6 billion		(CALCOMP)
	OHBAYASHI : OHBAYASHI GUMI Ltd.	$ 2.8 billion	SPACE PLANNING SYSTEM for ARCHITECTURAL COMPOSITION & EVALUATION FORWORD system FOR WORKING PLAN ANALYSIS, REVIEW and DRAFTING (CADAM)	TADD TOTALIZED ARCHITECTURAL DESIGN & DRAFTING SYSTEM
	TAKENAKA : TAKENAKA KOMUTEN Co. and Corp.	$ 2.5 billion	CANDIS COMPUTER AIDED NORMALIZED DESIGN and INFORMATION SYSTEM CANDIS-T	PLANNET
apartment housing developer	HASEGAWA : HASEGAWA KOMUTEN Co.			(CADAM)
house maker	SEKISUI : SEKISUI HOUSE INDUSTRY Co.		AUDESEI-I AUTOMATIC DRAFTING & ESTIMATION IN SEKISUI	AUDESEI-II AUDESEI-III

Tab. 1 Available typical architectural CAD systems in Japan

2. Present status of CAD use in construction field in Japan

Tab. 1 is a list showing famous, what they say, CAD systems actually used in Japanese construction-related enterprises, and enlists big five construction firms (general contractors), two top housing makers for high-rised housing and prefabricated house and a public corporation for telecommunication nationalwide. You can see most of the major firms have already their own CAD systems.

Japan has a specific character in construction in that there are many prefabricated house makers of various types and scales of production. Their total share is about 13 % of newly built houses in these years. Most of the prefabricated houses are made of wooden and/or light gauge steel construction and composed of panal and space unit components. These construction systems have good adaptability for CAD use in nature, so that most of the prefabriated house makers have also their own CAD systems in drawing and quantity estimation steps.

Large construction firms in Japan have also inevitability to utilize computer-oriented technologies. They have both construction and design divisions and have large portion for set-contract of design and construction. As mentioned above, there is tough and stiff competition in this field, companies have grown up through the efforts to get better position. Takenaka and Ohbayashi-Gumi were once top runners as for CAD use among the construction firms, and especially Takenaka had used CANDIS system as an effective tool to get contracts by presenting detailed evaluation and estimation outputs for planned projects.

Stimulated by the successful CAD use , other firms started to take their own steps to develop better CAD systems well-fitted to their design and construction processes. It is natural that system integration has been a central subject through each development. We have yet few really-integrated computer-aided " design " systems in actual use, but newly developed STEP system of Shimizu Construction Co. is considered to be well qualified for that kind of CAD system. Ohbayashi-Gumi's TADD system is also announced to be intedrated, but is behind STEP as for integration level at present.

STEP, Shimizu Total Engineering Process, was planned to consist of a six-steps at first as follows;

step 1 : for schematic design process
step 2 : for preliminary design process
step 3 : for detail design process
step 4 : for design information retrieval
step 5 : for construction control and planning aid
step 6 : for quantity estimation and shop drawing

Actually, step 1 was completed as STEP 1 in May,1982 and step 2 and 3 were completed in April,1983 to be combined in as STEP 2. Remained steps 4,5 and 6 were just completed in April this year and total STEP system was established. The period of development is 5 years in total.

STEP can support every design stage from schematic to detail and every design phase, i.e. architectural, structural and functional. It is available in use with data network nationalwide and LAN , Local Area Network in offices. It has no limitation for building type, volume and site location. Total design efficiency estimates to be improved by 10 % in total design activity. Shimizu has always about two thousand construction sites in home and overseas and is to apply personal micro computers to every site and connect with the host STEP system. This system may be used not as mere CAD tool but as CAE, CA- Engineering, tool totalizing whole production process from planning to maintenance.

General contractors in Japan are seeking for new technical and managing advancement in multi directions through such approaches as CAD/CAM, CAE, PM (Project Management), EC (Engineering Construction), TQC (Total Quality Control) and so forth. All of them need systematization and integration. CAD technique plays an important role in these to-be totalized systems, but it should be noticed that CAD use is indeed one of the necessary conditions but is not a sufficient one for their final objectives.

3. Research and development of a national project to advance construction technologies

Ministry of Construction of Japan annually sets up one or two general technological development projects, which have much publicity, technical feasibility and innovativeness and social adaptability. In construction, especially in architecture, technical method or

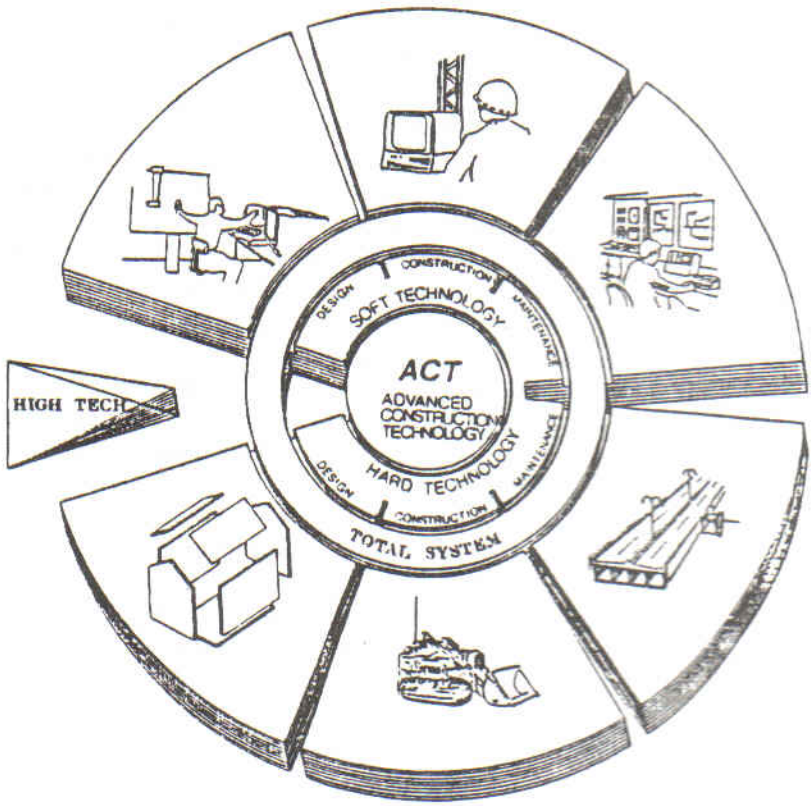

Fig. 1 ACT, new general technical development national project

specification is much more important than materials or machinery. The latter is primarily subject to MITI, Ministry of International Trade and Industry. Although the budget of a project of Ministry of Construction is usually much smaller than that of MITI, the result of the development makes much influence to the construction field by its nature. It was decided legally, two years ago, that some sorts of building must be checked the earthquake resistant performanceby newly developed computer-oriented evaluation method, which is one of the fluitful outcomes of this series of project.

Fig. 1 shows a new project started in April, last year whose code name is ACT, Advanced Construction Technology. The full name of this project is "Development of of Advanced System for Construction Technologies with Proper Use of Electronics" and the development period is five years. The main objective is to make the way clear how to advance construction technologies in the sight of totality by properly and effectively utilizing high technologies.

The ACT system consists of three principal items. The first two are individual elementary technical ones in software- and hardware-oriented approach respectively and the third is a totalization of the system in integrational approach. In this project, soft technologies relate to computerized information processing and hard ones relate to new construction method with robots and other automatized mechanisms. The third main item evaluates each applicational development and totalizes into wholly integrated operational system.

CAD is of course one of the elementary subsystems of this project. We had already developed an experimental CAD prototype for a systems building named GOD, Government Office-building Development. The system aims to impliment an open component system for small or middle scale office buildings. It is planned to revise this prototype to be more realistic and wider-ranged in the ACT project.

As is shown in Tab. 1, NTT, Nippon Telegraph and Telephone Public Corporation, has developed a on-line information processing system called DEMOS and makes useful services for medium and small size enterprizes throughout Japan who can not afford to own computers. There are more than three thousand users of this TSS service. About half of them are construction firms and design offices.

DEMOS consists of piecemeal drawing and evaluation programs at present. But NTT has started to build the INS, Information Network System, which combines telecommunication and information processing to provide cheaper and more convienient communication media to its customers and an integrated CAD system for DEMOS users is presently under development in relation to this movement. Programs are to be mutually connected through files with common database in its center. It is planned to utilize this network in the ACT project, therefore, the research and development of the project will be carried out in proper coorporation with DEMOS development teams.

4. Present status of the fifth generation computer project in Japan

The last item is on the fifth generation computer system planned in our country to be completed by 1991. As for CAD system development, generation is also discussed. Of course the generations are not necessarily the same with those of cpu or computer architecture formulation. The notion and requirements for the fifth generation, however, is considered common to the both, and is much the same with the new (innovative) generation.

If the computer is to be able to aid or assist human design activities, computer-aided technologies should be refined and sophisticated as human beings do. A designer does not decide or evaluate relevant factors only by data-formulated informations. Present computers can support only the portion of human intellectual abilities. Computers should acquire the same sort of intellectual competence with human beings to really aid such an activity as designing.

There are many requirements for the fifth (or new or next) generation CAD systems. Integration is of course one principle factor, but high speed data processing, calculation and knowledge processing are also needed. As for high speed super computers, many sorts of approaches are taken in the world, and MITI has also a national project to develop a new super computer with 10 GFLOPS speed. NEC, one of the mainframers in Japan, has already developed a prototype of the non Von Neumann type computer. There is innovative progress in the hardware of computer technology.

The fifth generation computer systems project was launched by MITI in fiscal 1982 after 3 years of investigations to impliment a knowledge information processing oriented computer system, remained behind. Fig. 2 shows four typical functions required for this system.

The fifth generation computer is planned to have abilities to find a proper solution for a given problem by itself through inference mechanism from knowledge information in mass storage, to classify, memorize and retrieve knowledge information which consists of data, rule, meaning and so forth, to understand natural and various types of conversation between human beings in terms of natural language, voice, sentence, figure and graphic and finally to automatically convert a given program into a effective computer program.

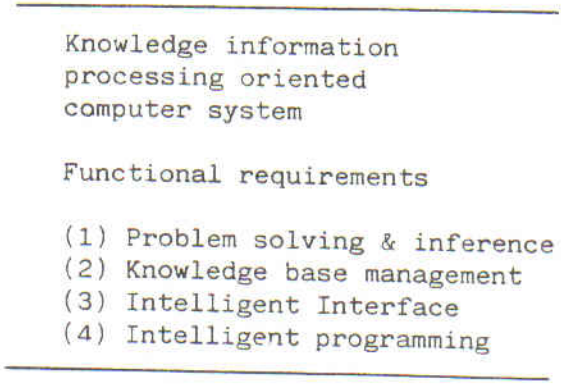

Fig. 2 Goal of the FGCS project

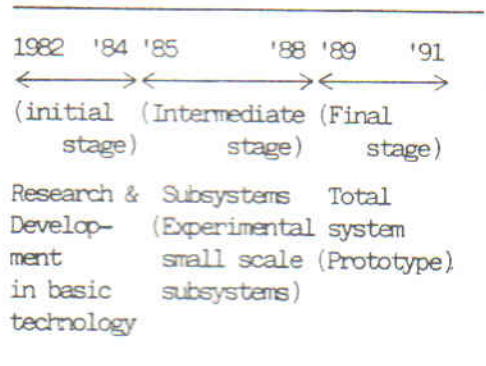

Fig. 3 Time schedule of FGCS project

Fig. 3 illustrates roughly how this project will proceed. Specific planning for commercialization will come after 1991. Computer manufacturers and others are expected to work on the development of commercial or operational systems. This project aims to bring the computer technology to a new stage by changing its basic design philosophy. In this sense, therefore, the initial stage from 1982 to 1984, this year, is very important to the project.

Fig. 4 shows detail outline about the development items and their relations. As for inference function, the expected execution speed is from 100 million to one billion LIPS, i.e. Logical Inference Per Second. This speed estimatedly corresponds to 10 to 100 thousand MIPS, so that FGCS is to have a speed three hundred to three thousand times as fast as the present ordinary mainframe computers. Data flow style parallel execution method is adopted to achieve this high speed. A thousand CPUs are to be connected in parallel.

As for knowledge base function, expected knowledge base machine is to have sophisticated relational data base function and knowledge operational mechanism. This machine has two major objectives; to be able to store from one hundred to one thousand GB data and to retrieve them in a few seconds.

As for intelligent interface function in which CAD has much interest, 99 % of the sentence inputs are analized correctly in syntax and 95 % of the audio inputs by ordinary speakers are to be recognized inspecifically. About one hundred thousand graphic patterns can be processed as knowledge information. Software productivity is planned to be up to ten times as much as the present one with Kernal Language as OS and Programming language.

The current development status of the project is generally on the schedule and partly ahead of it. The major outcomes at present are as follows;

1. a Kernel Language Prototype
2. a prototype hardware system for sequential inference machine
3. a relational data base machine called DELTA as the basic part of knowledge base machine

Greater effort must be needed from now on. But the bud is present. We need to make it grow by cooperation worldwide. By so doing we can really usher in a new computer age. Then CAD technologies may become a real designing tool.

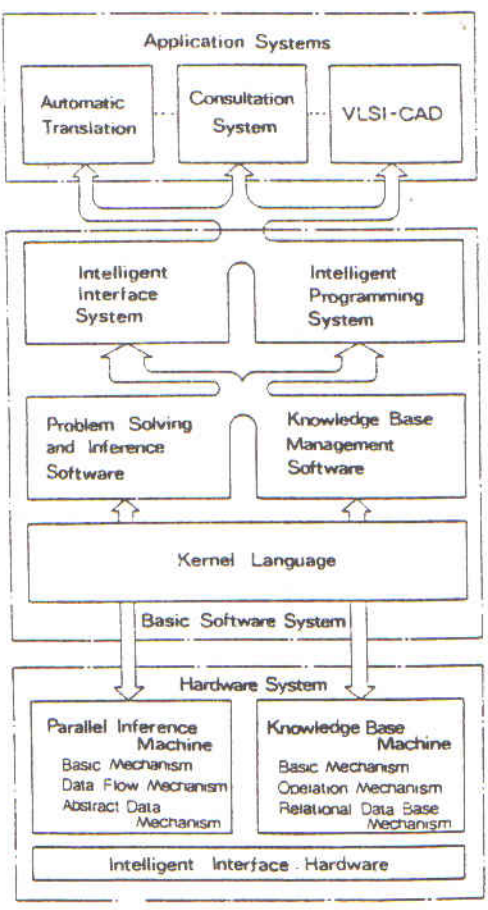

Fig. 4 Relationships of items